American Machinist

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Special Apprentices

H. W. DUNBAR
Manager, Grinding Machine Division
Norton Company

A machine tool concern appraises the skilled labor in its plant and takes steps to avoid a future shortage of expert hands

Apprentices are given practical instruction in the operation of various machine tools. In this picture one of the boys is shown operating a Lucas horizontal boring mill while the foreman stands ready to offer advice and check the work

NOW THAT the smoke of the depression has begun to clear away and we are taking an inventory of what we have on hand in the way of material, it seems logical that we should inventory our personnel as well. A few months ago, at the Norton Company, we did this and we found that our foremen and machinists in the shop were for the most part men well along in years—some close to the pension age. We also recognized that most of the applicants for jobs were unskilled in machinist's work or had never applied themselves for any length of time to a particular training. We found also that the most promising of the younger men in our organization were those who had been trained by us five and ten years ago in our apprentice training course, which at that time was of three years duration.

It was only natural then, putting these facts together, the need for men, the realization that good men were not available, and the remembrance that the old apprentice course furnished machinists of the type we wanted, that we decided to revive the apprentice course.

The new training course lasts eighteen months. During this time the apprentice is assigned to some department in our shop. Here he receives specific training in some branch of machine work, as for example, on the milling machines, the boring mills, or in the lathe department. At the end of each working day, all the apprentices spend one hour in a class room lecture, listening to various men in our organization on subjects pertaining to machine work. Before the course is completed, each apprentice will spend a few days in the other departments in the shop, with an opportunity to see the various types of machine tools in operation, and at least acquire a speaking acquaintance with them. However, our real objective is to train a man in some one line, the intention being, of course, to assign a man to that same department upon the completion of his course. We have in mind that the men selected as apprentices are potential gang leaders, assistant foremen, and foremen.

An address before the National Machine Tool Builders' Association at Atlantic City, October 3, 1934.

· APPRENTICE · AGREEMENT ·

This Agreement is made in triplicate this.....day of....., 19..., between the Norton Company doing business in Worcester, Massachusetts, hereinafter known as the Employer and..... ....., of ....., ..., hereinafter known as the Apprentice, and ..... of ....., ..., hereinafter known as Guardian, whose relation to the Apprentice is that of .....

For the purpose of acquiring the Art or Trade of Machinist, said ..... hereby becomes an Apprentice to said Employer and said Employer hereby accepts him subject to the terms and Rules and Regulations herein stated, and such other rules and regulations as may be at the time of the signing of the Agreement or thereafter in effect.

1. The Apprentice and his Guardian hereby promise that the Apprentice shall conform to and abide by all provisions of the Agreement, and shall faithfully serve his Employer during the full period of time named in this Agreement.

2. The Apprentice and his Guardian agree that the Apprentice shall do all in his power to learn said art or trade during the period of this apprenticeship. They also agree that apprentices shall attend classes after regular scheduled working hours, for which work the scale of pay herein set forth does not apply. Apprentices shall do a reasonable amount of home work as required by the instructors.

3. It is further agreed by the Apprentice and his Guardian, that the Employer shall have the right to discharge the Apprentice for inability to do the work or acquire the knowledge necessary for graduation, infraction of Rules and Regulations governing Apprentices and to rearrange his working hours should the state of business warrant it.

4. The practical training will consist of a specific training in some shop department where the Apprentice will spend the major portion of this time. He will also have a brief period of study in several other shop departments to round out his practical training.

5. The Employer agrees to assign certain members of its organization to the task of instructing the apprentices in such subjects as the reading of drawings, planning work, Methods Department routine, and such other subjects, which in the opinion of competent members of the Employer's organization, would be suited to the training of an Apprentice.

6. It is agreed by the Employer and Apprentice and his Guardian, that the period of apprenticeship shall be eighteen months, or a total of not less than 3,000 hours nor more than 3,200 hours.

7. The Guardian of said Apprentice, on his or her part, covenants and agrees that the Employer may pay to the Apprentice all wages and compensation which may become due for his services.

8. The Employer shall pay the Apprentice for services rendered as follows:

1st 15 weeks—25¢ per hour
2nd 15 weeks—28¢ per hour
3rd 15 weeks—31¢ per hour
4th 15 weeks—34¢ per hour
Last 18 weeks—37¢ per hour

If the Apprentice works on piece work, the bonus, as figured by the rules pertaining to piece work for Apprentices, will be added to the above pay for services.

9. Due to general conditions beyond the control of the Employer, it may be necessary to revise the above figures from time to time.

10. Apprentices shall have the right to terminate this agreement for satisfactory personal reasons, and upon proof of the same, the Employer shall furnish a statement terminating the agreement without stigma to the Apprentice.

Rules and Regulations Governing Apprentices at Norton Company

1. Applicants for apprenticeship under this agreement must not be less than sixteen (16) years of age, must possess the equivalent of a grammar school education, and Parent or Guardian must present birth or school certificate giving age of applicant.

2. Apprentices shall adhere to and abide by all Shop Rules and Regulations.

3. The first two months of the apprenticeship shall constitute a probationary period, or trial term. The apprentice shall receive credit for the time served during the probationary period, when it is satisfactorily completed.

4. This Agreement does not go into effect until the probationary period has been satisfactorily completed, and may be annulled by either party during the trial term.

5. All lost time must be made up before passing from one pay division to another.

6. The Employer reserves the right to suspend work in the shop, wholly or in part, at any time it may be deemed necessary. In such case, the Apprentice shall be paid only for the actual time he shall work. An Apprentice who has been suspended because of business conditions, shall have the option of resuming training before any additional apprentices are employed.

7. Should the conduct within or without the shops, or the work of the Apprentice not be satisfactory to the Employer and the Director of Apprenticeship of the Chicago Branch, National Metal Trades Association, the Apprentice may be dismissed at any time without previous notice, but may be reinstated after a conference with Parent or Guardian.

8. Each Apprentice who has faithfully and satisfactorily completed his apprenticeship shall, in consideration of the full and satisfactory completion of this agreement and in accordance with these rules, be presented by the employer with a certificate setting forth that he has so completed his term.

In Witness Whereof we have hereunto set our hands and seal, this....day of....., 19...

	APPRENTICE
WITNESS	PARENT OR GUARDIAN*
WITNESS	EMPLOYER

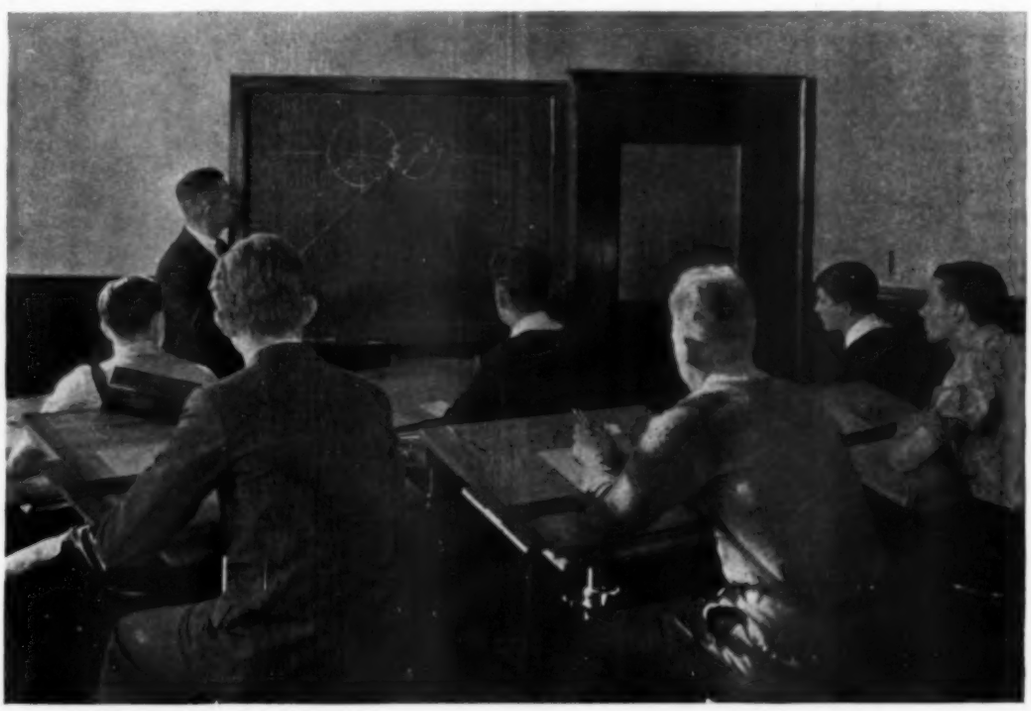
*Father should sign if living and available; otherwise, mother. Legal guardian should sign in absence of parents.

Practical instruction is given in the use of various machinist tools. Here the apprentice is being taught how to handle a micrometer. He is shown measuring the shaft which he has just ground. Note the apprentice's tool kit in the right background.

For the work the boys do in the shop, they are paid according to a schedule which gives them 25 cents an hour at the start and is increased three cents an hour every 15 weeks, with the result that when they graduate from the course, their pay is just about at the level of a third class operator in our shop, or about 40 cents an hour. We believe that the boys will earn this money by the work they will do during their eighteen months of training. They will spend some time in the tool crib, part of their time as utility men, or as clerks to the foremen, besides actually working on a machine.

An applicant for this apprenticeship should be at least sixteen years old (we prefer boys about eighteen). He must possess the equivalent of a grammar school education, and he must be mechanically inclined and present a good appearance. The selection of these boys has proved something of a problem, as in these days it is obvious that there are many applicants for the few apprentice positions we have to offer. As a solution the selection is determined, not by any one individual but by a committee consisting of our chief engineer, production engineer, equipment engineer, sales manager, two general foremen, and myself. Applicants meet these men individually, and great care is taken to outline the course so that there will be no misunderstanding. Various questions are asked each applicant and from the way he answers these, his alertness, attentiveness, ambition, previous experience, habits, and other characteristics can be determined, which in turn enables us to make a selection. Each man on the committee then forms his own opinion and presents it in writing at a committee meeting. On the basis of these opinions the boys are selected, and we feel that our chances of selecting the wrong boy are minimized in this way.

We have a written agreement which is signed by each aprentice, his parent or guardian, and the Norton Company, so that there will be a complete understanding between all concerned as to



The course is rounded out with classroom instruction. Here is a group of apprentices learning the rudiments of mechanical drawing

the scope of the course, the pay, and the rules and regulations. One of the provisions in the agreement is that the first two months will constitute a trial period during which time either the boy or the Norton Company can terminate the contract. After that we expect the agreement will be binding and that the boy will do his part and we in turn promise to instruct him according to the program.

Reading Drawings

Briefly, the lecture work is divided into eight subjects: engineering, tools, materials, jigs and fixtures, planning, methods, inspection, shop mathematics. The engineering work covers general instructions on how to read engineering drawings with some practice in the use of drawing instruments. We do not expect to make draftsmen of these apprentices, but we expect them to have a good working knowledge of engineering drawings.

The lectures on tools are given by various foremen in the shop and consist in a theoretical and practical explanation of such tools as the center punch, calipers, micrometers, sine bar, and indicators. For example, a man lecturing on a micrometer will take the instrument apart, show the boys the theory of it, and the accuracy and workmanship in the tool as well as showing them how to use it and how to care for it.

These first two subjects cover most of the lecture time, although a few weeks are spent on the other subjects, notably on shop mathematics where simple problems are given on gear ratios, pulleys, levers, and the practical applications of plane and solid geometry.

How much does all this cost? It costs very little. We expect the boys will earn every cent that we pay them. Therefore, the only cost is the expense of the lectures. We do not have lectures every week during the eighteen months of the apprentice training, probably fifty weeks of five lectures, or 250 lectures in all, will cover the necessary ground. These lectures are being given entirely by men in our own staff; a designer from the engineering department will teach the boys how to read engineering drawings, a shop foreman will give another subject, and so on. The average pay of these men is less than a dollar an hour. Consequently the total lecture cost would not possibly be over $250 and the supplies used by the boys will not be over ten dollars each.

The cost per boy, of course, depends on how many there are in the course, but assuming that we have eight of these apprentices in training all the time, the cost is somewhere in the vicinity of $40 per boy. We think this is a small price to pay in view of the results which we expect to attain.

The expense is so small that we have not bothered the management for a special appropriation or budget, but have asked each department to contribute their share of the labor involved in the lectures. The miscellaneous expense, for supplies and the like, is charged to our general supervision account.

Incidentally the Company loans the boy a kit of tools, and the boy in turn pays a small amount each week to cover the cost of the kit. By the time the course is complete, the boy is ready to take his place at a machine.

For those who may be interested in the training of apprentices, it might not be out of place to mention that permission must be granted by the code authorities before a company may proceed, but our experience in dealing with the Supervisory Agency indicates that a program such as I have outlined to you meets with their approval; in fact they enthusiastically encourage such an undertaking by any manufacturing concern.

Shaft Burnishing for Wear Resistance—Discussion

T. E. STUART

Referring to John E. Hyler's article (*AM*—Vol. 78, page 538) the practice of burnishing journals, or to be more precise, finishing by rolling, is a relic of the days when car axles were made from wrought iron. The fibrous structure of wrought iron made it difficult to obtain a smooth finish suitable for a journal with any kind of a cutting tool, although good results were often obtained with a wide faced water finishing tool, if the lathe was sturdy enough. In the days of wrought iron axles, such lathes were none too plentiful. Rolling was resorted to and produced as good a finished surface as could be desired, with excellent wearing and running qualities in the type of bearing used for car journals.

With the general adoption of open hearth or homogeneous steel for axles, the necessity for the rolled finish no longer existed. Grinding can produce an entirely satisfactory finish in a fraction of the time. With steel, a good finish must be put on the journal before the rolling is done, while the grinder can produce an equally good finish for journal purposes from the rough turned surface in much less time.

A most excellent example of the suitability of the ground journal is found in the automobile motor crankshaft. The demands upon it in service are exceedingly severe and failures are seldom or never chargeable to the character of the journal surface. It is doubtful if rolling could in any measure improve the wearing qualities.

Equipment and Work in a Contract Shop

Single purpose machines, in the sense of performing a single operation, have no place in a contract shop. But a cam cutting machine, while it cuts nothing but cams, finds a place in such shops to handle cams of various kinds that form part of many special machines. As an example of this one well known shop building special machinery recently installed a second cam cutting machine.

The machine equipment policy of this company is to keep its machines in first class condition and to buy new standard machines when occasion warrants. This occasion may be due to machines having outlived their usefulness, or, as in the recent additions, to a need for greater capacity. One of the activities during the early days of the depression was to overhaul thoroughly every machine that had seen any appreciable amount of service and to put it in first class condition. Accuracy and dependability as well as the ability to handle a variety of work are the prime requisites of machine tool equipment in such a shop and machines are selected with these points always in mind.

The average work in the building of special machines requires a varied machine equipment with drilling, planing, boring and milling as the four main operations to be performed. This naturally divides the work among machines of the types named and consequently divides the work among different groups of workers.

After the estimated time has been approved by the shop foremen the work goes into the shop on a premium basis. All saving up to 50 per cent is shared equally by the men and the company. Should the saving in time exceed this figure it is considered as evidence of great error in setting the time and the premium above this point is at a lower rate.

Foremen share in the bonus on a "per hour" basis of all time saved. This makes an incentive for them to help the men in every way possible, such as seeing that they have material and tools when they need them, suggesting improved methods, assisting in laying out the work, or by any other means in their power. This plan has worked well over a period of years and has proved thoroughly satisfactory to both men and management.

Rate Setting for Small Lots

T. O. GILLER

Drilling a simple flange is used to illustrate a method of setting standard times when lot sizes do not permit complete time studies

BEFORE starting an explanation of the rate setters' tables, perhaps a few words as to what they are and why they were developed may be of interest.

The best way to find out how long it should take to do a job is to have a good man do it, make adjustments of feeds, speeds, tools, and during the demonstration make a time study. This is about the only way in which anyone would attempt to set piece work, or bonus rates, on work that is on a quantity production basis.

There are, however, many cases where such a course is not possible. In a shop that is not on quantity production, is it not practicable to make a time study on every job before setting a piece or bonus rate and, even in a quantity shop, estimates must often be made before material is available. In such cases we are obliged to fall back on comparisons with previous jobs, which are only somewhat similar and to allow for the differences. Anyone who has done this a few times knows how unsatisfactory it is because:

1. Of the difficulty and time required to find a suitable comparison.

2. If we are lucky enough to find a record of an exactly similar piece, how do we know whether the performance was good, bad or indifferent? It is dangerous to tie up with a single record.

3. If we cannot find a record of an exactly similar piece we have to make allowances for the differences. It is easy enough to make a guess—perhaps an intelligent one—but it is only a guess at best. Anyway, it is hard to make a good guess giving the correct weight to a number of minor differences, though plenty of men are ready to take a shot at it.

Furthermore, an estimate based on a mere over-all record might prove difficult to meet; while, on the other hand, if it has been based on an analysis of detailed time studies there should be no difficulty in demonstrating how it could be met.

A rate setting table overcomes, or at least greatly reduces, all these difficulties. It provides a quick and convenient means of splitting the new piece of work, on which an estimate is required, into its elements. Times are then put on these elements from data tabulated, not from one, but from many detailed studies which have been so analyzed and arranged as to give proper weight to changing dimensions. The sum of these elemental times gives a reliable total estimate on the job as a whole. Lastly, the recorded data as to speeds, feeds, etc., enables the estimator to speak confidently as to how the operator should proceed in order to meet the estimate.

For an illustration, it may be well to explain the procedure in setting a rate on the flange sketched on the accompanying rate sheet. The operation constitutes drilling, reaming and counterboring four holes, using a fixture.

We start with the job allowance which according to the rate sheet is 3.0 min.; than proceed and add an additional set-up allowance, in this case for a fixture, 2.5 min. We then take into account tool adjustment—in this case drill 0.30 min., reamer 0.30 min., counterbore 0.30 min. By adding these up we get 6.40 min. which is the total set-up time.

After having determined this we continue with the per piece time (Table II). Place and remove the fixture 0.22 min.; drill four $\frac{21}{64}$ holes four tool adjustments at 0.04 min. = 0.16 min. Machine time (Table IV) at 0.62 min. per hole = 2.48 min. The operator removes the fixture and places the part to one side completing the first cycle.

The second cycle includes placing and removing the part for counterboring and reaming the four holes. (Place and remove part 0.08 min.). Counterbore $\frac{3}{4} \times \frac{1}{8}$ in. four holes = 4 × 0.20 for $\frac{1}{8}$ in. depth × counterbore factor, 1.3 (Table IV) = 1.04 min. plus four tool adjustments at 0.04 = 0.16 min. (Table II). Ream four holes = 0.62 for each 1 in. travel × 4 holes × 0.5, reaming factor (Table IV) = 1.24 plus four tool adjustments at 0.04 = 0.16 min. Adding the complete machine time, place-remove time and tool adjustment time gives a total basic time of 5.68 × the conditional allowance (an allowance for fatigue and conditions over which the operator has no control, in this case, say 20 per cent) 5.68 × 1.20 = 6.82 min. In other words this 6.82 min. is the standard time for drilling, spotfacing, and reaming four holes in the flange (See sketch on the rate sheet).

This standard time can be fitted into any kind of wage incentive scheme. Personally, the writer prefers the so-called standard time plan using bonus factors to suit the particular class of operators and conditions.

If bonus plans of the above kind are to be most effective waiting for tools at the crib or waiting for tools to be sharpened should be eliminated. Arrange to have a tool utility man whose responsibility is to see that the operator is supplied with one or two jobs ahead of him and the necessary tools for these jobs.

The tool utility man will have to work in conjunction with the foreman at all times in order to get out the most urgent jobs first.

BASIC ELEMENT TIME TABLE PER JOB ALLOWANCE — Sensitive Drill Rate Table No. 1

JOB ALLOWANCE	3.00 min.
ADDITIONAL SET UP ALLOWANCE	
Table 1 Bolt	2.00 min.
" 2 "	3.00 "
" 3 "	4.50 "
" 4 "	5.50 "
Angle Iron	1.00 "
Vise	2.00 "
Fixture	2.50 "
V-Clamp	2.00 "
C-Clamp	0.25 "
Drill Arbor	0.45 "

Use as needed on every job. Set-up includes placing of bolts, straps, blocks vise, fixture and first piece. Also removing of vise, fixture, bolts and straps.

FIRST TOOL ADJUSTMENT	
1 Drill, Reamer, Tap or Counterbore	0.30 min.
2 Drill, Reamer, Tap or Counterbore	0.60 "
3 Drill, Reamer, Tap or Counterbore	0.90 "
4 Drill, Reamer, Tap or Counterbore	1.20 "
Tapping Chuck	0.35 "
Set Spindle Stop	0.50 "
EXTRA	
Per Stop	1.00 "
Per Jack	0.50 "

Use as needed on every job. First tool adjustment includes placing of tools in spindle setting spindle to proper depth for c-bores, drills, etc., and also removing tools from spindle.

BASIC ELEMENT TIME TABLE PER PIECE ALLOWANCE

Sensitive Drill Rate Table No.2

Place and Remove Fixture or Jig	0 Lb.-15 Lb.	15 Lb.-50 Lb.	50 Lb.-80 Lb.
Jig, fixture and table using 1 bolt	0.22	0.37	0.60
" " " " " 2 "	0.32	0.47	0.70
" " " " " 3 "	0.42	0.57	0.83
" " " " " 4 "	0.52	0.67	0.93
Place and remove part	0.08	0.38	0.56
Pick-up from table spot drill, (hand) drop in container	0.10		
Pick-up from table, center punch spot drill, (hand) drop in container	0.14		
Pick-up from floor, center punch, secure in vise, spot drill (vise) release and drop in container	0.38		
Pick-up from floor, secure in vise, spot drill (vise) release and drop in container	0.31		
Pick-up, hold with pliers, spot, countersink, and drop	0.16		
Blowout chips with air when tapping blind holes Per hole	0.04		
Attach part with screw (first screw)	0.22		
" " " " (each additional screw)	0.15		

Deep Hole Drilling

Tool adjust 0.08 for every inch over 3" up to 5" in depth
" " 0.10 for every half inch over 5"

Measuring All Allowance

Use of scale	0.25
" " micrometer	0.50
" " verniers	0.75
" " surface gage	0.25
" " bevel protractor	1.00
" " bevel	0.25
Slip bushing in each jig	0.15
Stamp - per figure	0.12

Tool adjustment - per hole 0.04 — Use on every job having more than one hole

BASIC ELEMENT TIME TABLE MACHINE TIME ALLOWANCE

Sensitive Drill Rate Table No.3

Hard Cast Iron - Cast Steel - Drop Forge - Tool Steel

Diameter of Drill

Depth of Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2	5/8	3/4
1/16	.12	.08	.05	.03	.02	.04	.06	.07	.07	.08	.08	.10	.11	.12	.12	.13	.14
1/8	.22	.15	.08	.07	.05	.07	.08	.09	.10	.11	.11	.13	.14	.15	.16	.18	.20
3/16	.31	.21	.11	.09	.06	.09	.11	.12	.13	.13	.13	.16	.18	.19	.19	.20	.21
1/4	.40	.27	.14	.11	.07	.10	.13	.15	.16	.17	.17	.20	.22	.23	.23	.24	.25
5/16	.49	.34	.18	.14	.10	.13	.15	.17	.18	.19	.19	.22	.25	.26	.26	.27	.28
3/8	.59	.40	.20	.16	.11	.14	.18	.19	.20	.21	.22	.25	.28	.29	.29	.30	.31
7/16	.68	.46	.24	.18	.12	.16	.20	.22	.24	.24	.24	.28	.31	.32	.32	.33	.34
1/2	.77	.52	.27	.21	.14	.18	.23	.25	.26	.26	.26	.31	.35	.36	.36	.37	.38
5/8	.96	.64	.32	.25	.17	.22	.28	.30	.31	.32	.32	.37	.42	.43	.43	.44	.45
3/4	1.14	.77	.40	.30	.20	.26	.32	.35	.37	.38	.38	.43	.48	.49	.50	.52	.53
7/8	1.33	.90	.46	.35	.23	.30	.37	.40	.42	.43	.43	.49	.55	.56	.56	.58	.59
1	1.51	1.02	.52	.39	.26	.33	.42	.45	.48	.49	.49	.50	.61	.62	.62	.64	.65
1 1/8	1.70	1.14	.58	.44	.29	.38	.47	.50	.53	.54	.55	.62	.68	.69	.69	.71	.72
1 1/4	1.88	1.26	.64	.48	.32	.42	.52	.56	.59	.60	.60	.67	.74	.75	.76	.78	.79
1 3/8	2.07	1.38	.70	.53	.35	.46	.57	.61	.65	.65	.65	.74	.82	.83	.83	.85	.86
1 1/2	2.26	1.51	.76	.57	.38	.50	.61	.66	.70	.71	.71	.80	.89	.90	.90	.92	.93
1 3/4	2.62	1.76	.89	.67	.44	.58	.71	.76	.80	.81	.82	.92	1.02	1.03	1.03	1.05	1.06
2	2.99	2.00	1.01	.75	.50	.65	.80	.85	.91	.92	.92	1.04	1.15	1.16	1.16	1.18	1.19
2 1/4	3.36	2.25	1.13	.85	.58	.74	.90	.96	1.02	1.03	1.03	1.17	1.30	1.31	1.31	1.33	1.34
2 1/2	3.73	2.49	1.26	.94	.64	.81	.98	1.06	1.13	1.14	1.14	1.29	1.43	1.44	1.44	1.46	1.47
2 3/4	4.10	2.74	1.38	1.03	.70	.90	1.09	1.17	1.24	1.25	1.25	1.41	1.56	1.57	1.57	1.59	1.60
3	4.48	2.99	1.50	1.13	.76	.98	1.19	1.26	1.34	1.35	1.36	1.53	1.69	1.70	1.70	1.72	1.73

Metal Conversion Factors

	Drill	Ream	Tap	Counter-bore	Counter-sink	Spot Face
Cast iron	1.00	0.5	0.5	1.00	1.00	1.3
Other Material	1.00	0.7	1.50	1.3	1.3	1.3

BASIC ELEMENT TIME TABLE MACHINE TIME ALLOWANCE

Sensitive Drill Rate Table No.4

Mild Steel - Malleable Iron

Diameter of Drill

Depth of Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2	5/8	3/4
1/16	.10	.08	.05	.04	.02	.03	.04	.05	.05	.06	.06	.07	.07	.10	.12	.13	.14
1/8	.22	.16	.08	.07	.05	.05	.05	.06	.07	.07	.07	.09	.10	.12	.16	.18	.20
3/16	.31	.21	.11	.09	.06	.06	.07	.08	.08	.09	.10	.11	.12	.16	.19	.20	.21
1/4	.40	.27	.14	.11	.07	.08	.08	.10	.11	.11	.11	.12	.13	.18	.23	.24	.25
5/16	.49	.34	.18	.14	.10	.10	.10	.11	.12	.13	.13	.15	.16	.21	.26	.27	.28
3/8	.59	.40	.20	.16	.11	.11	.11	.13	.14	.14	.14	.16	.18	.24	.29	.30	.31
7/16	.68	.46	.24	.18	.12	.13	.13	.15	.16	.17	.17	.19	.20	.26	.32	.33	.34
1/2	.77	.52	.26	.20	.14	.14	.14	.16	.18	.18	.18	.21	.23	.30	.36	.37	.38
5/8	.96	.64	.32	.25	.17	.18	.18	.20	.22	.22	.22	.24	.26	.33	.43	.44	.45
3/4	1.14	.77	.40	.30	.20	.20	.20	.23	.25	.25	.25	.28	.31	.40	.49	.52	.53
7/8	1.33	.90	.46	.35	.23	.24	.24	.27	.29	.29	.29	.33	.36	.46	.56	.58	.59
1	1.51	1.02	.52	.39	.26	.26	.26	.29	.31	.32	.32	.36	.40	.51	.62	.64	.65
1 1/8	1.70	1.14	.58	.44	.29	.30	.30	.33	.35	.36	.36	.40	.44	.52	.69	.71	.72
1 1/4	1.88	1.26	.64	.48	.32	.33	.34	.37	.40	.40	.40	.44	.48	.61	.76	.78	.79
1 3/8	2.07	1.38	.70	.53	.35	.36	.37	.40	.43	.44	.44	.49	.53	.68	.83	.85	.86
1 1/2	2.26	1.51	.76	.57	.38	.39	.40	.44	.47	.47	.47	.53	.58	.69	.90	.92	.93
1 3/4	2.62	1.76	.89	.67	.44	.45	.46	.50	.54	.54	.54	.60	.66	.84	1.03	1.05	1.06
2	2.99	2.00	1.01	.75	.50	.51	.52	.57	.61	.61	.61	.68	.74	.95	1.16	1.18	1.19
2 1/4	3.36	2.25	1.13	.85	.58	.58	.58	.63	.68	.68	.68	.77	.83	1.07	1.31	1.33	1.34
2 1/2	3.73	2.49	1.26	.94	.64	.64	.64	.70	.76	.76	.76	.84	.92	1.18	1.44	1.46	1.47
2 3/4	4.10	2.74	1.38	1.03	.70	.70	.70	.76	.83	.83	.83	.92	1.01	1.29	1.57	1.59	1.60
3	4.48	2.99	1.50	1.13	.76	.76	.76	.83	.90	.90	.90	.98	1.09	1.40	1.70	1.72	1.73

Metal Conversion Factors

	Drill	Ream	Tap	Counter-bore	Counter-sink	Spot Face
Mild steel	1.0	0.7	1.5	1.3	1.3	1.3
Malleable iron	1.0	0.5	0.5	1.0	1.0	1.0
Leadscrew steel	1.3	1.3	1.86	1.65	1.3	1.65

BASIC ELEMENT TIME TABLE MACHINE TIME TABLE

Sensitive Drill Rate Table No.5

Aluminum - Brass - Bronze - Babbitt

Diameter of Drill

Depth of Cut	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2	5/8	3/4
1/16	.02	.02	.02	.02	.02	.02	.02	.02	.01	.01	.01	.02	.02	.02	.02	.03	.04
1/8	.04	.04	.04	.04	.04	.03	.02	.02	.02	.02	.02	.04	.05	.05	.05	.06	.07
3/16	.05	.05	.05	.05	.04	.04	.04	.04	.04	.03	.02	.04	.05	.05	.05	.06	.07
1/4	.07	.07	.06	.06	.05	.05	.04	.04	.04	.04	.04	.05	.05	.05	.05	.06	.07
5/16	.08	.07	.06	.06	.05	.05	.05	.05	.05	.05	.05	.06	.06	.06	.06	.07	.08
3/8	.10	.09	.07	.07	.06	.06	.06	.06	.05	.05	.05	.06	.07	.07	.07	.08	.09
7/16	.11	.10	.08	.08	.07	.07	.06	.06	.06	.06	.05	.06	.07	.07	.07	.08	.09
1/2	.13	.12	.10	.09	.08	.08	.07	.07	.06	.06	.06	.07	.08	.08	.08	.09	.10
5/8	.17	.15	.12	.12	.11	.10	.08	.08	.07	.07	.07	.09	.10	.10	.10	.11	.12
3/4	.19	.17	.14	.13	.12	.12	.11	.11	.10	.09	.08	.10	.11	.12	.12	.13	.14
7/8	.22	.20	.17	.16	.14	.13	.12	.12	.11	.11	.10	.12	.13	.13	.13	.14	.15
1	.25	.22	.19	.18	.16	.15	.13	.13	.12	.12	.11	.13	.14	.14	.14	.15	.16
1 1/8	.28	.25	.22	.20	.18	.17	.15	.14	.13	.13	.12	.14	.16	.16	.16	.17	.18
1 1/4	.31	.28	.24	.22	.19	.18	.17	.16	.14	.14	.13	.16	.18	.18	.18	.19	.20
1 3/8	.34	.31	.27	.24	.21	.20	.18	.17	.16	.16	.15	.18	.20	.21	.21	.22	.23
1 1/2	.37	.33	.29	.26	.23	.21	.19	.18	.17	.17	.16	.19	.22	.23	.23	.24	.25
1 3/4	.43	.39	.34	.30	.26	.25	.23	.21	.19	.19	.18	.21	.24	.24	.24	.25	.26
2	.49	.44	.38	.34	.30	.28	.25	.24	.23	.22	.20	.24	.28	.28	.28	.29	.30
2 1/4	.56	.49	.42	.39	.35	.32	.29	.27	.25	.24	.22	.27	.31	.31	.31	.32	.33
2 1/2	.62	.55	.47	.43	.38	.35	.31	.30	.28	.26	.24	.29	.34	.35	.35	.36	.37
2 3/4	.68	.59	.52	.47	.42	.39	.35	.33	.30	.28	.26	.32	.37	.37	.37	.38	.39
3	.74	.65	.56	.52	.47	.43	.38	.35	.32	.31	.29	.35	.41	.41	.41	.42	.43

Metal Conversion Factors

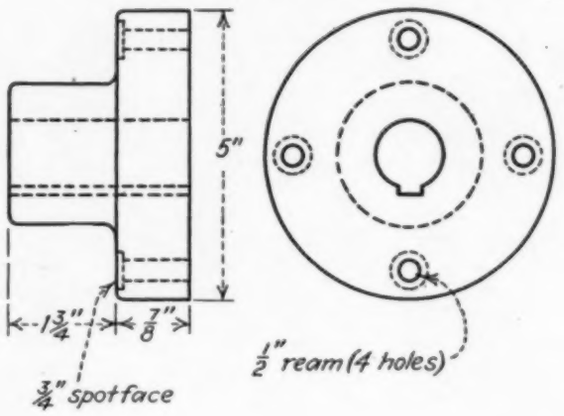
	Drill	Ream	Tap	Counter-bore	Counter-sink	Spot Face
Aluminum	1.0	0.7	0.4	1.0	0.8	1.0
Babbitt	1.0	0.7	0.4	1.0	0.8	1.0
Brass	1.0	0.7	0.4	1.0	0.8	1.0

Element Time and Rate Sheet

Part Number 378962

Machine *Sensitive Drill* | Material *Machine steel* | Dept. #62 | Operation No. 2

Plate Setters Remarks or Sketches



Part Name *Coupling*

Set-up Elements	Minutes
Job allowance	3.00
Fixture	2.50
Drill	.30
C. Bore	.30
Reamer	.30
Total	6.40

Discription of Elements	Operation Factors: Depth of Cut	R.p.m. or Stroke	Feed / Rev.	Time / Inch	Tool Travel	Number of Cuts	Tool: Mat. Factor	Element Time (Minutes): Machine Time	Place Remove	Measure	Tool Adjust.	Total
Place-Remove (Fixtures)									.22			.22
Drill 31/64"				.62	1"	4		2.48			.16	2.64
Place-Remove (Part)									.22			.22
Spotface (1/8" deep)				.20	1/8"	4	1.3	1.04			.16	1.40
Ream				.62	1"	4	.5	1.24			.16	1.40
										Total		5.68

Tools - Fixture - Jigs (For above oper.)

Fixture T-762
Drill 31/64"
Reamer 1/2
C-Bore 3/4" x 31/64"

Rate Changes

Reason	Date	By	App. By

Summary of Rate

Set-up Time: Basic Time	Bonus Factor	Hours	Allow. Hours	Per Piece Time: Basic Time	Cond. Allow.	Bonus Factor Hours	Allow. Hours
6.40	×1.4 ×1.6 ×1.9 ×2.	×1/60 ×1/60 ×1/60 ×1/60	.15	5.68	2.40 ×1.20 2.30 ×1.10 ×1.20 ×1.30 ×1.10 ×1.20 ×1.30	1.4×1/60 1.6×1/60 1.9×1/60	.16

Set-up Rate = .15 hr. | Per Piece Rate = .16 hr.

Figured By *T.O.Y.* Date *5-4-34*

Approved *T.O. Giller*

Redesigning the Turret Lathe for Cemented Carbide Tools

WM. J. BURGER
Works Manager, The Warner & Swasey Company

DEVELOPMENT of the cemented carbide cutting tool has stirred up again the old contest between the metallurgists and cutting tool manufacturers on the one side, and the machine tool builders on the other. First blood went to the metallurgists, but the machine tool builders have made good use of the depression years to strengthen and speed up their machines so that they can develop the full capabilities of the cemented carbides.

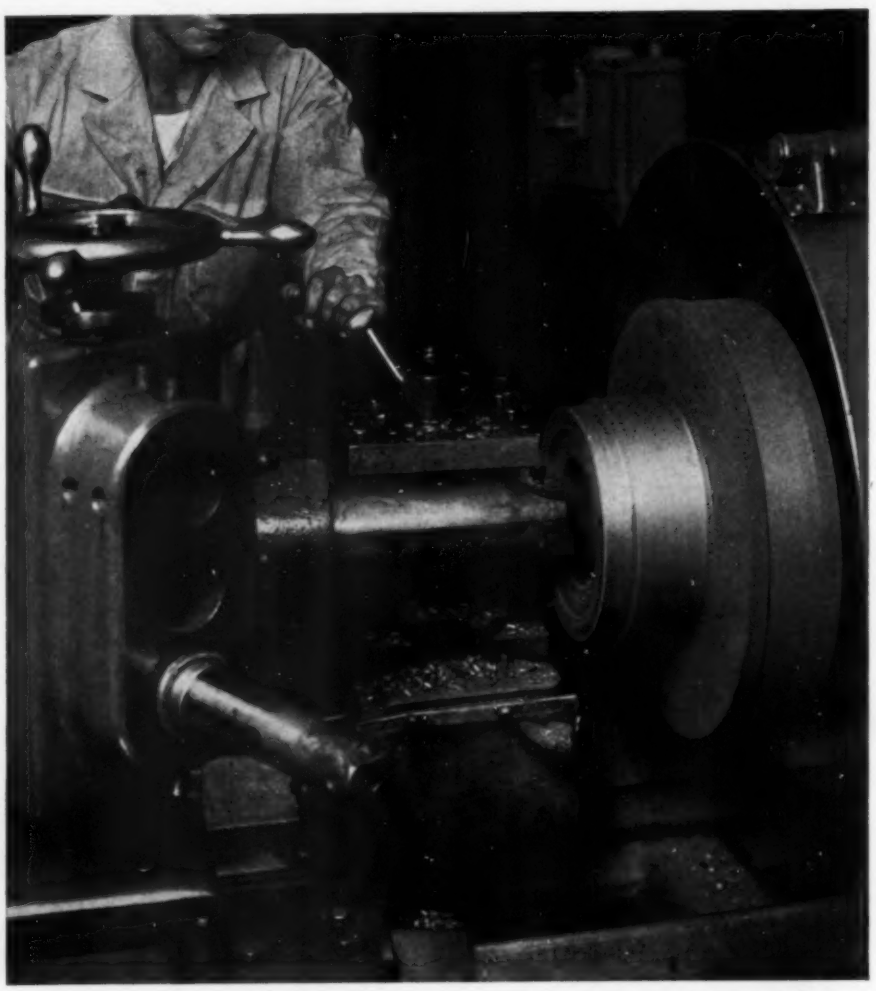
Early tests showed that vibrations in the mechanism traveled quickly to the cutting edge of the tool, with the result that chipping and breakage was excessive. Hence rigidity of the whole machine tool, but particularly of the tool holding and work holding elements, is an absolute requirement when carbide tools are employed. Since vibration is largely the product of the greatly increased speed at which carbide tools are usually operated, and greater speed involves an increase in power, new standards of rigidity had to be established.

To achieve these new standards of rigidity in Warner & Swasey turret lathes we started out by reducing gear shaft lengths and increasing their diameters. These changes brought the gears closer to the shaft supports and reduced potential vibration appreciably. As a consequence, however, we discovered that the teeth of the gears had to be strengthened and the accuracy of cutting raised materially.

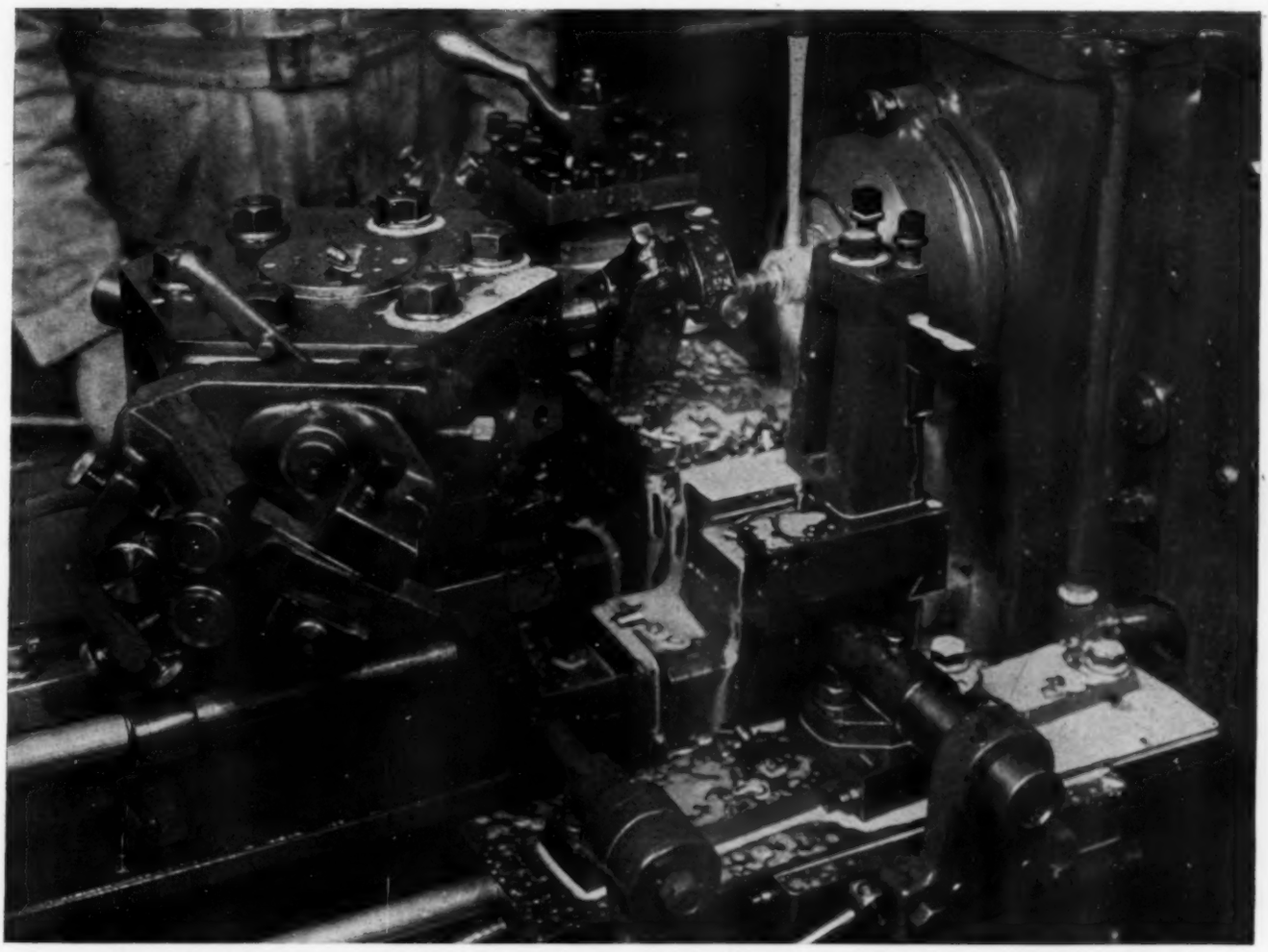
We also found that more rigid supports for the cutters were needed. The use of larger shafts was the answer.

The roll supports for the turning tools had to be made heavier and mounted on better bearings. To do this we secured a patent which enabled us to use a loosely mounted small roll of a diameter that would allow it to turn the smallest work which the lathe would be required to do. This small roll was inforced with a large, closely fitted roll, mounted on bearings.

The elimination of vibration, while a major problem, was not the only one which confronted the machine tool builder. An unexpected one was the disposal of chips. Cemented carbide, according to the material being machined, will cut from three to four times as fast as will high speed steel. The result is that the chip takes the form of a continuous wire which leaves the tool with amazing rapidity. Not only is this a safety hazard, but the wire-like chip displays a tendency to curl around the work. When this occurs, the machine



4-A turret lathe with cross-sliding turret cutting cast iron with cemented carbide tools. Surface speed—210 ft. per min. Longitudinal feed from square turret—0.090 in. Cross feed from hexagon turret—0.0874 in. Depth of cut—0.250 in. 35 hp. Rate of metal removal—106 cu.in. (26.5 lb.) per min.



Geared head No. 3 turret lathe turning and cutting off SAE-X-1315 cold finish screw stock with cemented carbide tools. Diam. of stock—1 5/16 in. R.P.M.—1,480. Speed—500 surface ft. per min. Turning feed—0.012 in. Cut-off feed—0.0045 in. Rate of metal removal—35.6 cu.in. (nearly 10 lb.) per min.

tool must be stopped and the chip cleared away, thus neutralizing to a considerable extent the time which has been saved by the use of the faster cutting tool.

Many experiments have been carried on to eliminate this waste. One idea centered around the installation of a chip breaker. This was finally abandoned in favor of grooving the cutting tool in such a way as to curl the chip into a tight compact spiral.

Another important factor is the necessity for shortening the handling time, so that a larger proportion of the actual operating time may be put to useful purpose. With a slower cutting tool this is not so important. But as soon as the cutting time is reduced by a third or a half, it becomes essential that the handling time be reduced at least in the same proportion or there will be little or no actual production gain.

This saving can be accomplished, in part at least, by methods that will permit the operating speeds of the machine tool to be changed more quickly. The old method of shifting belts from one drive wheel to another has been replaced by the gear shift, and the machine tool as a result is faster, and more efficient. Now we must go a step beyond that and adapt the gear change of the modern automobile where speeds are shifted without in any way decreasing the momentum of the car. It is safe to say that this development will undoubtedly make its appearance in the comparatively near future.

At the same time it may be necessary, if full advantage is to be taken of the time saving elements of cemented carbide, to devise equipment that will actually be used to place the work on the machine tool and remove it again in fewer minutes than can now be done.

Finally, the workman himself must be given serious consideration if the most is to be gotten from the carbides and other higher speed metals that are, or may be put, on the market. The average mechanic must be taught to use these tools. He must, for instance, be taught to grind the new tools properly. To the uninitiated this may not seem important, but it really plays a considerable part in the efficient operation of cemented carbide. To work properly it must be actually honed. This is understandable when one considers the enormous speed at which carboloy tools operate, and that this speed demands an absolutely smooth surface on the tool so that the cut metal can slide over it readily.

Another thing that even the best mechanic must be taught is the proper speed to be used with different materials. Unless this knowledge is firmly grounded and used, much of the efficiency and economy will be lost. It is also essential that the workmen be shown exactly how a tool should be stopped in work.

These may sound like minor matters, but if I were equipping a shop with high speed cutting tools I would first train one man thoroughly in their use and would let him spend all of his time in passing his knowledge on to his fellow workmen.

Many of the problems that have been mentioned have already been solved. Others are in the process of solution.

Floating Bushings for Locomotive Rods

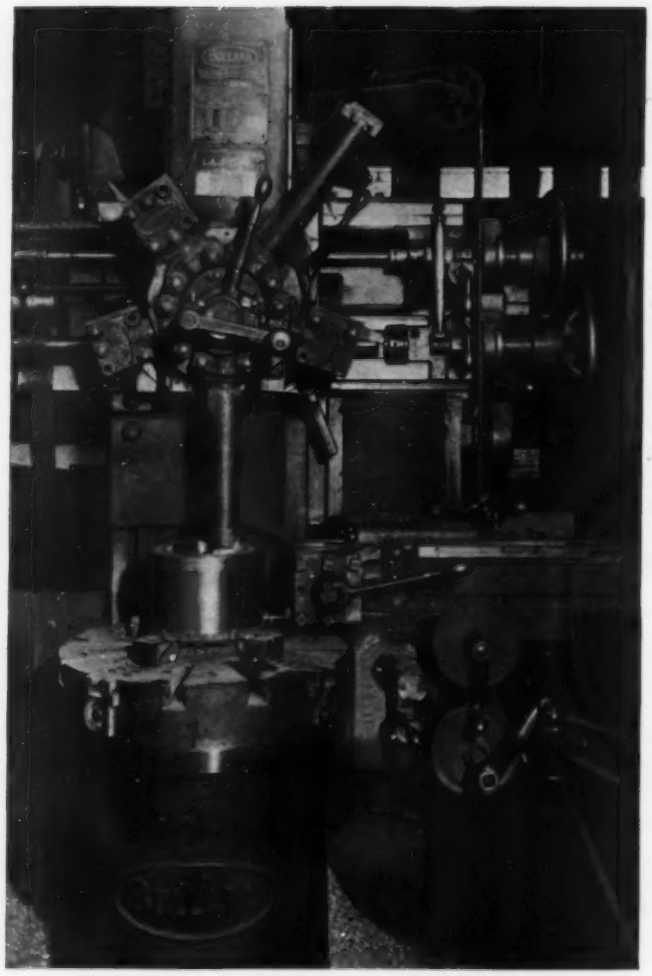


Fig. 1—Many shops find the side head mill an efficient unit for boring and turning the bushings

FLOATING bushings are now standard practice on most railways, and are made of brass or bronze. The mixtures vary, some using phosphor bronze and others special alloys. In most cases these bushings run in a cast-iron sleeve or bushing that is pressed into the rod end or otherwise held against turning. The floating bushing is free to turn on the crankpin and in the bushing. A close-grained iron, known as gun-iron, is being largely used in the stationary bushing. A fairly common method of machining these bushings is shown in Fig. 1, a side-head boring mill being well adapted to this kind of work.

On some roads floating flanges of bronze are also provided as in Fig. 2, which shows them in place both on the main and on intermediate crankpins. At *A* the outer flanges are held within working limits by the faces of the driving wheel and the eccentric crank face. Four flanges are used at *B*, the outer one being held by the crankpin collar as is the case with intermediate pin *C*. Fig. 2 also shows the clearances allowed at different points. Roughly speaking the floating bushings vary from 4½ to 10 in. inside diameter and are from ¾ to ⅞ in. in thickness.

The bushing in Fig. 3 is for the back end of a large main rod and is also as long as its diameter. The gun-iron bushing is held in the rod by a plain end on a special capscrew. The fixed bushing is 1/32 in. larger than the outside of the brass bushing. A groove is chipped lengthwise in the outer bushing, through the oil holes, to insure lubrication reaching the outer surface of the brass bushing. This floating bushing has seven rows of twelve holes each, ¼ in. in diameter and countersunk on the outside. It will be noted that the outer end of the brass bushing has a flange bearing against the end of the iron bushing outside. A collar against this outer face prevents the floating bushing from working out. Bushings for intermediate crankpins are made in a similar manner but with different dimensions.

One road uses a unique templet for drilling the holes through the walls of the floating bushings. A templet layout is shown in Fig. 4. These templets are of sheet steel thin enough to bend around the bushings easily. The holes are

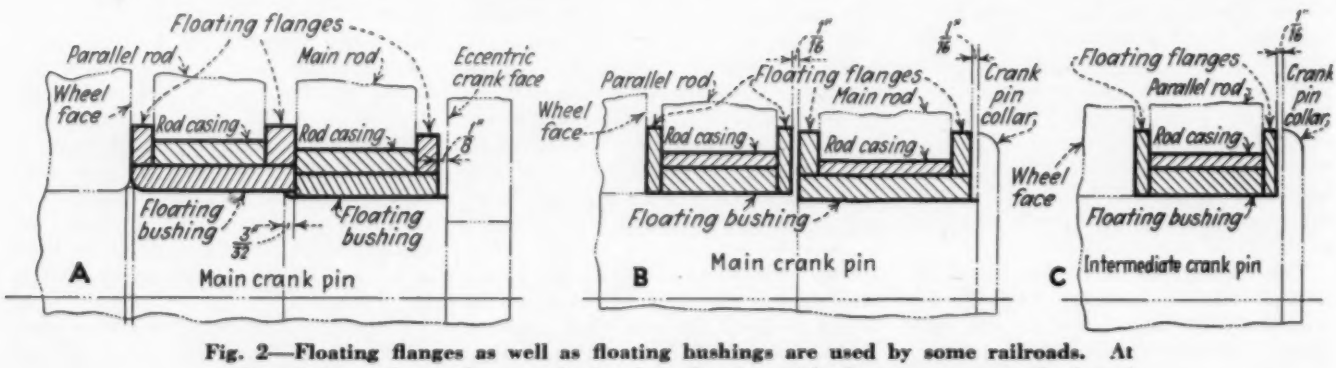


Fig. 2—Floating flanges as well as floating bushings are used by some railroads. At *A*, *B* and *C* are shown three methods of application with clearances commonly found

spaced 1½ in. each way and laid off at the angle of 1 to 4 as shown by the small triangle 1—4. The length *A* is made to suit the circumference of the bushing while the width *B* varies according to the length. The locations of the holes to be drilled are prick-punched at the intersections indicated by small circles. When the ends of the templets lap, the layout of the holes varies somewhat but in no case are they drilled closer than 1½ in. apart. The holes are drilled ⅜ in. in diameter in this case.

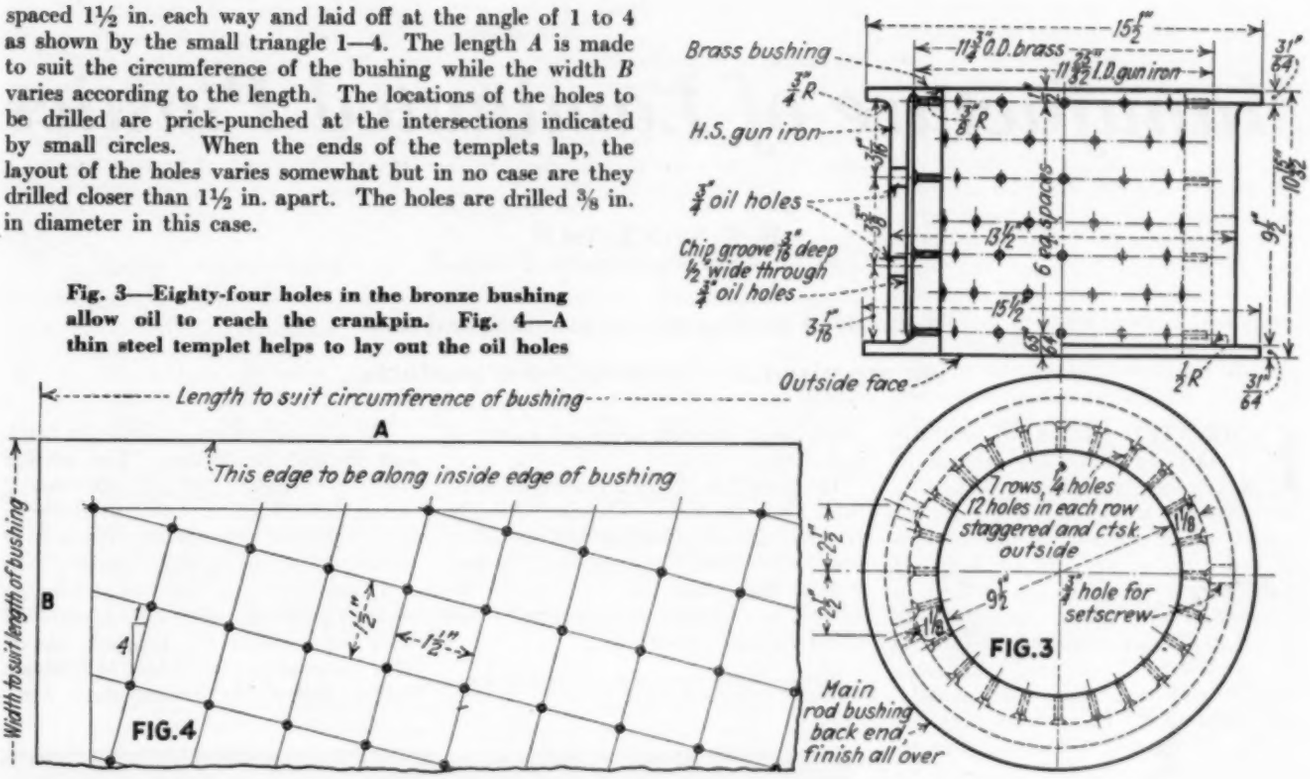


Fig. 3—Eighty-four holes in the bronze bushing allow oil to reach the crankpin. Fig. 4—A thin steel templet helps to lay out the oil holes

Old Age Pensions on a Sound Basis—Discussion

B. E. R. RENAUD

The pension plan submitted by G. Chauncy Parsons in an article under the title given above (*AM*—Vol. 78, page 567) would undoubtedly be satisfactory if a good workman were assured of a steady job in a permanent industry. But after the experience we are just going through, how many men would ever profit by such a pension system? We all know of men who have lost their jobs within a few years of the time they were entitled to a pension; of men who were laid off a few months before being eligible in order to remove them from the pension list; of men who worked for concerns that went under; and so forth.

We have also seen that the laws governing accident compensation, originally hailed as a step forward, have actually reacted detrimentally to the best interests of the workmen where a private insurance company has underwritten the risks. Physical examination in some cases are so strict that only young and physically perfect men can obtain jobs and are the cause of throwing a number of men (though over 45) on public charity.

The present depression has also shown clearly that many employers who preached loyalty toward the firm did not understand that the reverse should be true. There are a number of firms that hire and discharge men in direct relation to the work available, without any attempt to equalize the work and build up a permanent force. Incidentally, some of these (manufacturers of textile machinery for instance) make good profits, due to patent control or other causes. It is, therefore, useless to bring a condition of satisfied workmen into a pension plan. A just plan should protect all workmen, irrespective of age, affiliation or locality.

As I see it, on starting work, each man should automatically become eligible for pension. In each job, his contributions would be entered in a book similar to a bank book, while the employer's contribution would be sent directly to the government as a tax. This would eliminate the private profit, which would without question create conditions similar to those that obtain in compulsory automobile insurance. When the man arrived at the eligible age, he would present his book and obtain his pension. Thus a workman would receive credit for the time he worked during his life, irrespective of the concerns that hired him, and those men who do not work or do not want to work, would receive pensions commensurate with their efforts.

Of course, this is only a rough outline. Plans will have to be studied to protect the men who run their own business and to establish pension rates that will give a minimum return. Evidently it would be out of reason to give a pension that was based only on length of service and earnings, as some high-salaried employees of corporations would receive amounts way beyond any sum required by men when they reach the retirement age.

What Is a 14-in. x 6-ft. Engine Lathe?—Discussion

C. A. COPPACK
Leicester, England

Referring to the article under the title given above (*AM*—Vol. 78, page 439), I am somewhat amused at the question. While it is agreed that a lathe should be spoken of in terms of diameter of the work it will turn, the cross-feed screw is still equipped with a micrometer collar graduated to give thousandths of an inch in radius, although the "mike" will show two thousandths in diameter.

Manufacture of Laminated Plastics

H. E. STOCKFISCH
Consulting Engineer

Methods of impregnation, molding and testing are given for phenolic resin products

LAMINATED products of synthetic resins are important because of their highly desirable properties. The products are finding a greatly increased use in engineering, manufacturing and architecture, and are regarded as an important contribution to the field of materials with special properties. In these materials are combined the features of electrical insulation, hardness, strength and toughness, machinability, and appearance. In addition they are capable of resisting effectively the actions of heat, wear, and industrial solutions, as well as being non-warping.

A laminated product may be defined as a dense composite material made by hot-pressing superimposed sheets of paper or fabric, impregnated with an organic binder. In the plastics field hot-pressing is referred to as "molding." The binder best suited to industrial products at present is synthetic phenolic resin.

A more thorough appreciation of industrial utilization of these products can be gained by illustrating with some actual figures showing monthly consumption. These figures are given in average volume per month based on the combined annual production of the manufacturers of laminated phenolic products.

Typical product	Monthly Volume
Plate—insulating, mechanical, gear.....	2,000,000 sq.ft.
Rayon spinning buckets.	6,000
Automotive timing gears	200,000
Tubes—all shapes.....	500,000 lineal ft.
Roll-mill neck bearings up to 18 in. diam.....	600
Protective helmets.....	1,500

The products are all produced either by one complete operation of molding in dies, by machining from plate, or by rolling in bars or tubes. This list covers only a limited range of use and does not include many applications for central station, radio, telephone and architectural service and for consumer goods, such as electric clocks and trays.

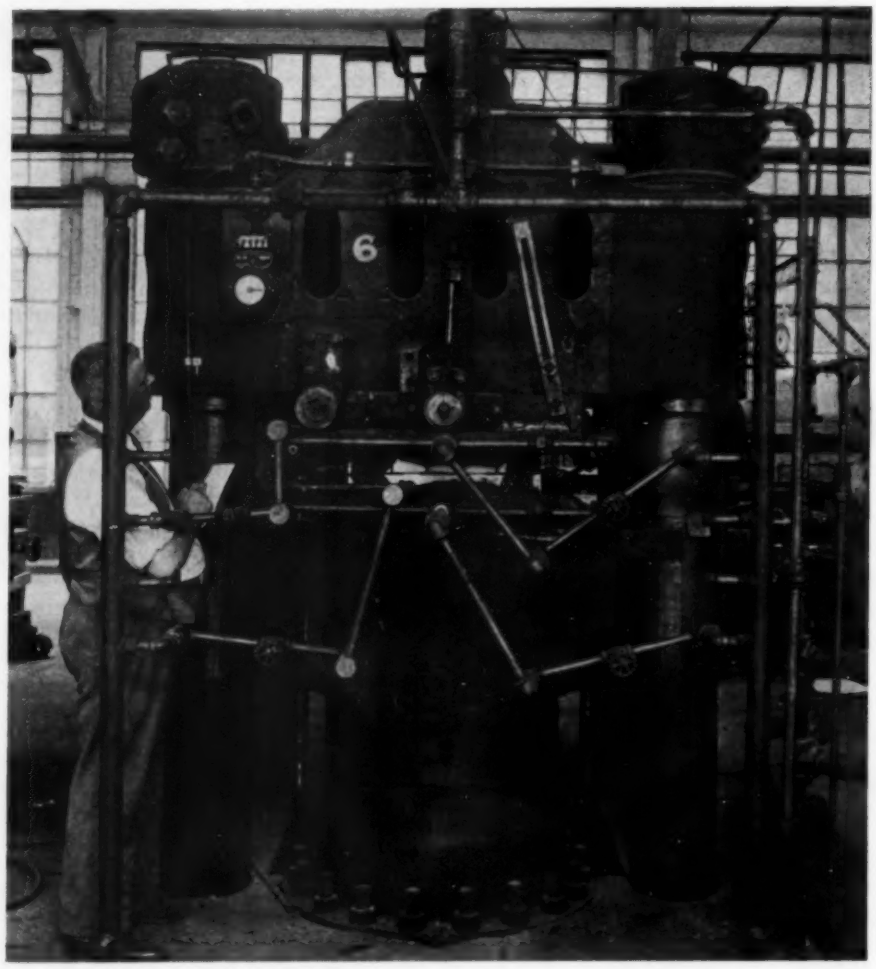
NEMA has recognized the industrial importance of laminated products by standardizing certain properties for suppliers and manufacturers of electrical apparatus.[1]

In Table I is shown a classification of laminated products following broadly the NEMA classification but including certain additional designations for materials with properties not usually required in electrical applications which are important elsewhere.

[1]National Electrical Manufacturers Association, publication 31-13.

These materials are available in black and natural tan colors. The surface finish is usually dull on all classes; classes XX, XXX, are also available in satin and high gloss finishes which have proved attractive for many applications.

A non-laminated product made by molding comminuted resin impregnated duck supplements the products above. This material can be molded in intricate shapes where the homogeneous lami-



Micarta trays are made in this press using 450 tons pressure. The resins and paper laminations are heated to 400 F. by steam which flows through the tray molds

nated construction would be impractical; for example, in escalator treads, timing gear webs, terminal blocks, golf-club heads, small motor housings, pin insulations, bobbins and bubbler caps for stills.

A description of the manufacturing processes, leading to the production of molded laminated phenolic products, includes resin manufacture, impregnation of paper and fabric, molding and commercial tests.

Since resin manufacture is essentially a chemical process its steps will not be given in detail. Several grades of phenolic resins are necessary to produce products with the required properties. Table II will illustrate this.

Table I—Classification of Molded Laminated Products

Class	Description	Application examples
X	Paper base, in which mechanical properties are of primary importance. Useful on low voltages under dry conditions (220 v.).	Bus bar covering panels, spacers, bushings, rods, tubes, simple insulation. Simple punchings. Low cost material.
P	Paper base, punching properties of primary importance.	Intricate punchings performed with ease. Widely used in radio field, etc.
XX	Paper base, general purpose material. Combines appearance, insulation, strength and uniformity.	Instrument panels, etc., where appearance and insulation are important. Punches if heated.
XXX	Paper base, comparable to XX but superior for low power loss and high frequency.	High frequency apparatus, high humidity as in tropics and marine work.
C	Duck fabric base, high mechanical strength, good insulating and machining properties. Flexibility good.	Most widely used in mechanical industrial products. Gears, pulleys, plate, bearings, etc. Punches to ¼ in.
CE	Same as C but with better electrical and machining properties. Excellent for resisting water absorption and mild chemical solutions.	Use instead of class C where better properties are required, as shown, on duck base. Useful when paper stock is not tough enough, also.
L	Fine weave fabric base. Combines excellent insulating, punching, machining, and appearance qualities.	Intricate punchings with close space between holes. Fine tooth gears (under 24 pitch) can be cut very small).
LE	Same as L but with better electrical properties. Machines cleaner than L.	Use instead of L where better properties of electrical insulation are required, as toughness combined with insulating value in humid conditions.
A AA	Asbestos paper base. Asbestos fabric base Electrical and mechanical properties generally lower than other classes.	Where conditions of elevated temperature exist, or where non-flammable base is desired. Turbo-generator channels of fabric, and plate stock of paper.
S	Special class. Covers wood base where laminations are of natural wood veneer as poplar, ash. Also such special requirements as freedom from odor.	Where excessively high strength is on direction is required as in circuit breaker rods. Odorless material useful in refrigerators, etc.
M	Not an electrical insulator. For mechanical applications only. Contains graphite.	Self lubricating gears, bearings, thrust washers, bushings, etc.

Table II—Phenolic Resin Types

Type	Example of Use
General purpose	for ordinary electrical applications and where mechanical strength is important. Most used type.
Electrical properties	for certain high voltage and low power factor plate.
Chemical resistance	resistant to water and chemical and industrial solutions.
Fast reacting	valuable for increasing mold capacity due to faster curing period. Mechanically good, inferior electrically.
Light colored	Most phenolic resins are red-brown. This type developed where colors are desired in the final products.
Others	Among other types may be included that for punch plate, for high penetration, etc.

Forty strips of paper an inch wide will carry the weight of a 1½-ton Ford. This vividly illustrates why a combination of resin and sheet material possesses such remarkable strength when molded together.

A laminated products plant covering the entire industrial and decorative products field will utilize over sixty different papers and fabrics, divided somewhat as follows: Paper—10 for electrical and industrial purposes, 20 solid colors, 15 wood designs; Fabric—5 types of duck, 2 asbestos fabrics, 10 cambric and cloth fabrics.

It can readily be understood that the properties desired in the final product are influenced largely by the sheet material. The colors and marble designs are most successful when impregnated with a colorless resin of the non-phenolic type, as stated elsewhere.

Absorbency is the chief common characteristic of all materials to be impregnated. To assume uniformity the mills are furnished with definite specifications for their guidance. For example, all materials must be free of any sizing or filling that would interfere with saturating qualities. Further, paper thicknesses which range from 0.0035 in. to 0.010 in. must not exceed a tolerance of plus or minus 0.0005 in.

Cotton fabrics range in thickness from 0.007 to 0.030 in. Their uniformity is controlled by the weight of a unit area, as, for example, a square yard, which may be 4, 8, 12, 15, 24, 30 ounces,

Intricacy of design possible with comminuted laminations is exemplified by this shoe guide and back pressure valve for oil-well drilling equipment

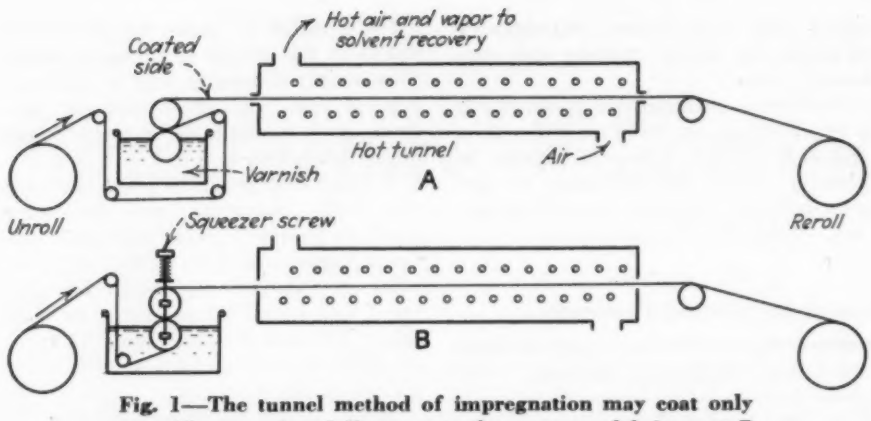
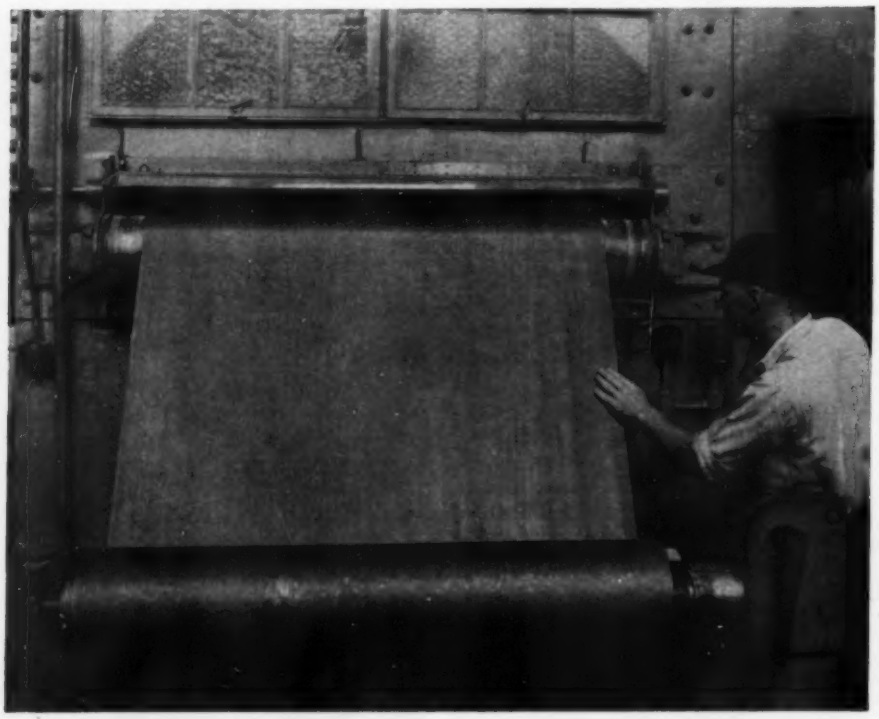


Fig. 1—The tunnel method of impregnation may coat only one side as at *A* or fully saturate the paper or fabric as at *B*



Impregnated paper leaves a tower type machine after having been dipped in troughs containing a resin solution from which the solvents are evaporated by passing the sheet over rolls

in weaves from cambric as in a handkerchief, to cord fabric as in automobile tires.

In the papers wood-pulp, alpha-pulp, rag-stock, and linters are utilized, either separately or in combination. The sheet material may be white, black, kraft, colored or printed, and range in density from a light soft calendered to a hard super calendered stock suitable for printing wood and marble designs.

The cotton entering into the fabrics is all long stapled American fiber.

The cost of the paper and fabric is high because of the special processing required at the mills. Paper prices start at 4½ cents per lb. for kraft to 40 cents or over for marble and other designs on super-calendered stock. Fabric prices range from 12 to 15 cents a yard for 8-oz. duck to about 13 cents a yd. for 4½-oz. cambric, each 37-in. wide. Woven asbestos fabric containing about 15 per cent cotton is more expensive than duck.

Some paper and cambric materials are obtained in widths up to 120 in. for use in final products of tubular shape. Ordinary widths used are between 37 and 50 in.

Impregnating machines are of the tunnel type, shown in Fig. 1 at *A* and *B*, or the tower type, shown in Fig. 2, sometimes referred to as horizontal and vertical treating machines, respectively.

Both types of machines are totally inclosed in metal and are constructed solidly with precision synchronizing gears, tension rollers, speed, air, and temperature control mechanisms, as well

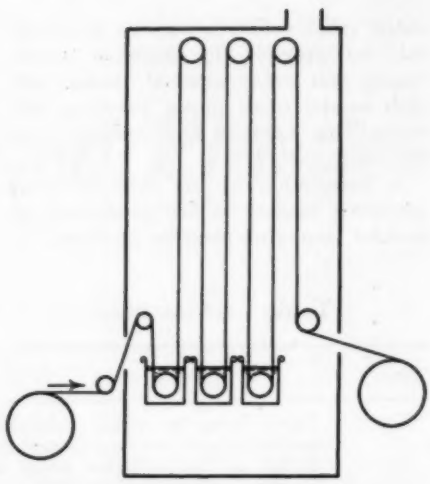


Fig. 2—A succession of dips may be used with the tower method

as varnish leveling and flow devices. The average length of the tunnels is 75 ft. The average height of the tower is 50 ft. Solvent recovery systems at least 85 per cent efficient can be connected as part of the layout.

The tunnel type of impregnator has as its chief purpose the high speed production of materials containing 40 to 50 per cent resin content, as well as the coating of dielectric paper on one side for tube rolling. Most of the material from these machines finds its use for the core of products placed between surface sheets having higher resin content.

The tower machines are principally for the purpose of producing materials with high resin content, up to 70 per cent, for surfaces of molded products. A succession of dips can be utilized, each having different degrees of penetrating power. Drying after each dip is accomplished by steam pipes and air baffles not shown in the diagrams.

Other impregnating and coating machines are available but are not suitable for the peculiar problems of resin varnishes. They are designed for specific purposes as materials impregnated with shellac, glue, asphalt, oil, sizings, waterproofing, etc., or for coating with paraffin, rubber, pigment, glazing, etc.

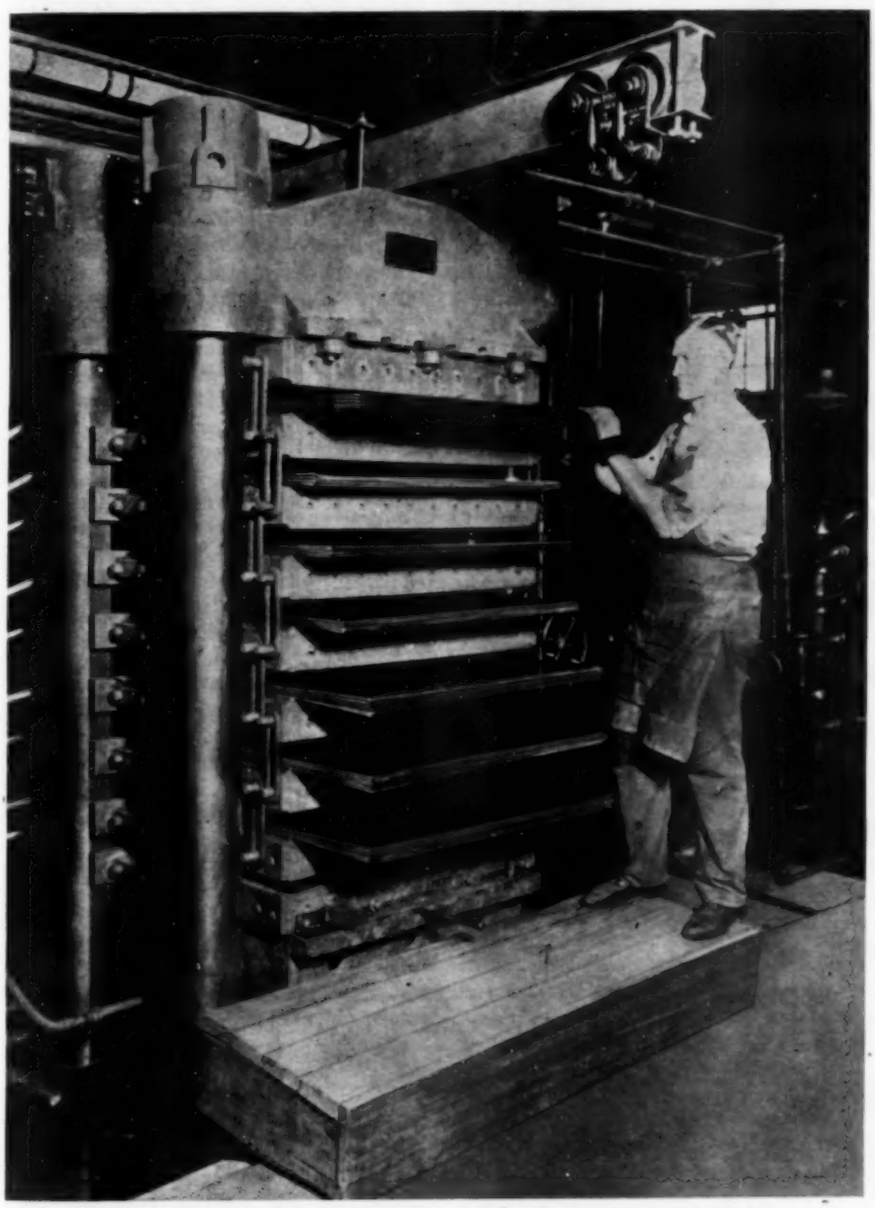
The cost of production is arrived at by adding the cost of the resin consumed, the cost of the paper or fabric consumed, the labor figure and overhead. An additional charge should be made for loss from scrap which on most of the output should be under 5 per cent if properly controlled. In spite of all precautions an occasionl higher loss will be sustained from imperfectly impregnated materials, usually on the surface materials. Cost of finished materials will range from 12 to over 60 cents per lb., with paperstuffs at each price extreme.

The quality of the impregnation

largely determines the success of the final molded products, and it is therefore necessary to appoint capable supervision and assistants. Resin varnish impregnations are still in the art status; when they become a science many headaches in impregnating departments will vanish, with the additional advantage of lower factory costs resulting from decreased scrap.

A few examples of the importance of impregnating quality can be given. When the resin has been dried too much the sheeted materials will not have a proper bond because of lack of flow of the resin in the hot molds or presses. Conversely, if the materials are underdried the flow will be too great resulting in tearing during molding, in addition, lowering of insulation strength, increase of water absorption, bad appearance, and difficulty of stripping from molding surfaces, to mention only a few defects. Too little and too much resin will have much the same effects as the overdried or underdried extremes, respectively. The problem of quality is heightened when it is realized that each of the sixty odd papers and fabrics require different processing from the standpoint of the various factors involved, namely temperature, speed, dilution, airflow, variations of weather, and changing operating shifts.

A decided forward step has been the progress made in the incorporation of resin with pulp at the paper mill. This results in what is termed beater-impregnated stock, and is supplied in flat sheets and rolls.



Laminated Bakelite is made by a 1,500-lb. pressure exerted by this multi-platen press. The finished sheets are adapted to many uses from automobile timing gears to wainscoting for buildings

The impregnated materials, after being checked for quality, are wrapped in strong waterproof paper, marked for identification, and either stored or used at once.

Molding

Final products are produced by placing the impregnated sheet material into molds or presses and baking under pressure. For example, to produce a plate of Class C material 1-in. thick, superimpose 96 sheets of 8 oz. duck containing 40 per cent resin between two ground steel plates ⅞ in. thick and place between hydraulic steam platens. Close the press and exert hydraulic pressure of 1,500 lb. per sq.in. and maintain a temperature of 175 C. (347 F.) for one hour. Then cool to room temperature, open the press, unload, and peel from the steel. The resulting molded plate will be solid, dense and composite, possessing the properties described for this class.

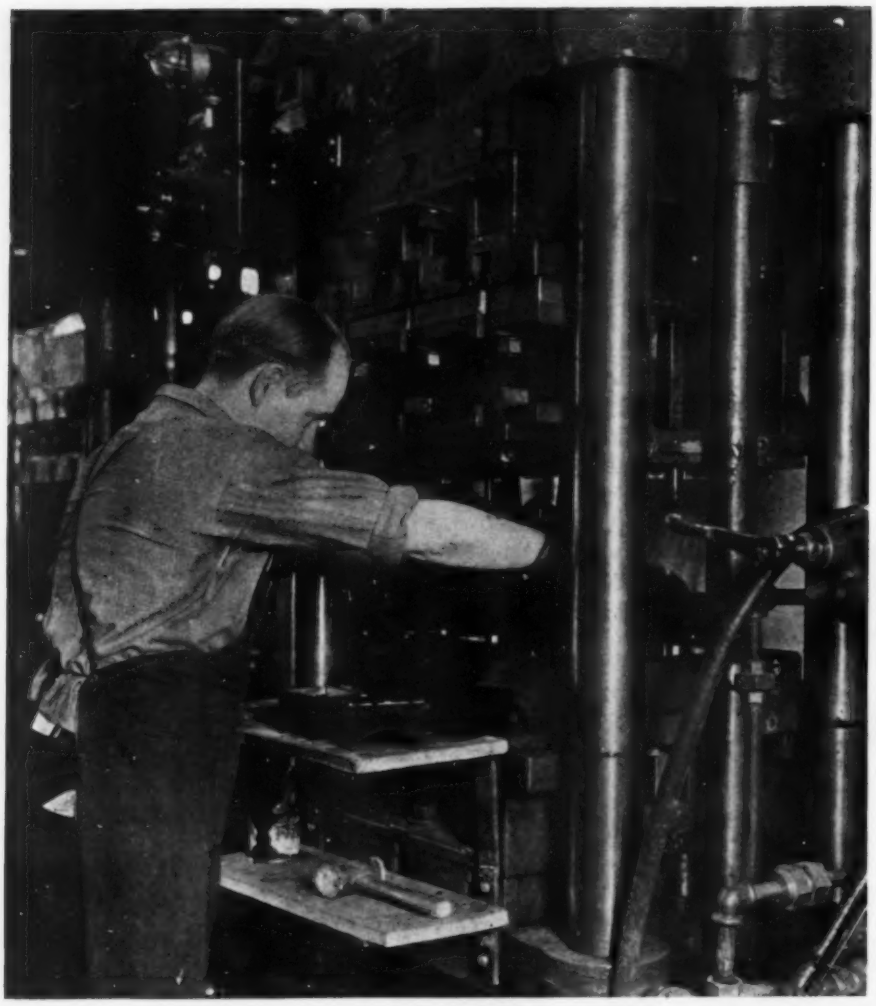
For a typical Class CE grade of the same thickness only 56 sheets are used, but the resin content is increased to 60 per cent. Similarly, a paper base grade, as Class X, would require 240 sheets of thin kraft paper containing 40 per cent resin. Both the class C and X plates would have a surface sheet of their respective materials on each side, containing a higher percentage of resin than the core, to improve appearance and prevent sticking to the steel.

Although the number of laminations in the duck plates was reduced nearly 50 per cent in the class C and CE plates, the strength drops only 10 per cent, excepting the bond strength, which increases about 75 per cent. It can be seen here that if costs of resins could be reduced materially it would be economical generally to increase the resin content, other requirements permitting.

The photograph showing an operator opening a press with seven openings of five plates each illustrates a typical press for producing plate. A metal separating leaf between each plate also serves to impart the various finishes. Stainless steel of the Enduro type is commonly used, in ⅛ in. thickness, often chromium plated as additional protection from wear, since the plates are used over a great many times.

Die-molded Products

Sheets placed between male and female steel blocks are pressed and baked into definitely shaped products. Molds may be heated indirectly from steam plates or directly by having the steam circulate through channels in the mold. The former is cheaper and satisfactory for simply shaped objects such as small channels; the latter is more expensive



The operator is removing molded casings from a multiple cavity mold mounted in a hydraulic press

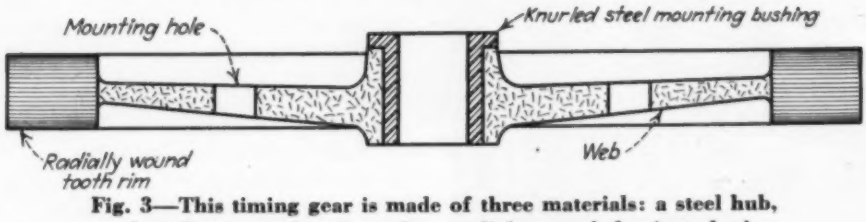


Fig. 3—This timing gear is made of three materials: a steel hub, a phenolic pressed web and a radial wound laminated ring

and must be used to mold such objects as spinning buckets, boxes and helmets, where the size and contour would prohibit proper baking with the former type.

The heat of baking causes the resin to react to its point of potential permanent hardness. At this point the resin is no longer soluble or fusible, which is the reason for its great value.

Steel used in mold construction must necessarily be tough and hard. Chrome-vanadium steel, as well as nitrided steel, finds wide application in these molds.

One mold block with several cavities is a common set-up. Six timing gear blanks may be molded simultaneously in one closing of a press. Certain products, as buckets for rayon spinning, and boxes for pneumatic conveyors, must be molded one per press because of the complexity of the mold parts. Timing gear blanks are an example of the utility of integrally molded metallic inserts, which form the mounting bushings. Both products are also examples of the necessity of supplementing the all-laminated duck-base construction with comminuted or macerated duck sheet. This material is used in the web of the gear blanks, and in the hub of spinning buckets. (See Figs. 5 and 6).

Unit pressure exerted on die-molded products ranges between one and two tons per sq.in.

All laminated products are subject to compliance with test specifications. A commercial test is made on each individual single plate and die-molded product. These tests always include dimensional and appearance inspection.

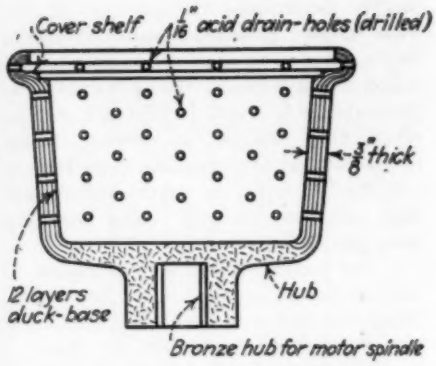


Fig. 4—Partly of laminated and partly of comminuted fabric, this rayon spinning bucket must pass a rigid balancing test

In specific products the customer will furnish a series of specifications covering weight, close thickness tolerance, minimum electrical insulation strength, and punching properties, as well as color matching and freedom from odors. The U. S. Navy, for instance, has exacting requirements for everything it buys, and phenolic laminated products are no exception.

Die-molded products are subject to some tests which are quite interesting. For instance, buckets for rayon spinning which in actual operation will revolve up to 10,000 r.p.m. with a load of about 4 lb. of spun rayon, are tested and adjusted on an Olsen-Lundgren balancing machine for static and dynamic balance as well as accuracy of physical dimensions to within a few thousandths of an inch. The surfaces must be perfectly smooth and vitreous. A dynamic mechanical spindle test on loaded buckets must come up to 10,000 r.p.m. without signs of distress or weaving, except through periods of natural vibration. At top speed smooth running must be attained. Since a bucket with its load weighs about 8 lb. it can be readily understood why smoothness of operation is necessary; otherwise power input and operating hazards are greatly influenced. An interesting development is that of the high speed motors on which the buckets are directly mounted by means of a spindle shaft which enters the socket in the bucket hub.

Another type of test run on a sample or two of each batch of daily production, is known as a "destructive test," which as the name indicates destroys the sample. An example is that of automotive timing gear blanks. Tests made are for bushing push-out, web deflection, rim-split, torsion, tooth load, and the routine dimensional and appearance inspections.

EDITORIALS

VOLUME 78 AMERICAN MACHINIST ESTABLISHED 1877 McGRAW-HILL PUBLISHING COMPANY, INC. NUMBER 22

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EDITORS

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CRITICIZE—BUT ONLY CONSTRUCTIVELY

SIGNS that the Administration is seriously concerned over the failure of recovery to come up to expectations are to be found on every hand. The reorganization of the high command of NRA, the sending of chief brain truster Tugwell to study in Europe, the interviews with financial, industrial and business leaders are straws that show how the wind is blowing.

In the early days of the New Deal Administration business was very definitely given the cold shoulder while organized labor was welcomed to the warmth of the Washington fireside. Labor leadership had its great chance to show that it recognized the mighty forces at work in our civilization, and that it had the will and the ability to utilize them for the good of all. It missed its chance.

Business now has its opportunity to prove its mettle. Working shoulder to shoulder with Washington it should be able to turn the tide of depression and save us all from the economic fallacies that have always beset labor, and have also befooled the New Deal leaders. No better exposition of these fallacies has been made than that contained in the speech of Ralph E. Flanders before those who helped to celebrate the fiftieth anniversary of the Cincinnati Milling Machine Company ten days ago. The gist of his argument appears elsewhere in this issue.

In his sturdy support of the principle that prosperity can only come from an increase in output of goods Mr. Flanders stands solidly beside Wisconsin's liberal university president, Glenn Frank. Dr. Frank's latest book, "America's Hour of Decision," states this principle of plenty in a fashion that defies dispute. We of the machinery industries welcome so doughty a defender, one who presents the case for the machine just as we have always envisioned it, but more lucidly than we less gifted users of English prose can hope to do.

The Flanderses and the Franks can state the facts and expound the principles. Business men must help Washington to make them work. In so doing it will be the reverse of helpfulness to accept all that the New Deal has set up. There are serious wrongs that must be righted, obvious omissions that must be filled in, utterly contradictory policies in different departments that must be reconciled.

IF BUSINESS LEADERSHIP is worthy of the name it will criticize these shortcomings vigorously but always constructively, and come prepared with its own plans for achieving that measure of recovery which the President so desires but which has thus far eluded his Administration. The immediate task is to sink the selfish differences and unite on constructive measures.

Social Legislation

THE STAGE is set for passage in the next Congress of bills authorizing old age pensions and unemployment insurance. Business men of the type that dreads change are frightened half to death at the prospect, and some of them are preparing to fight to the last ditch to prevent its materialization. But are they wise? Would they not be better advised to come forward with plans for these socially desirable developments that would give them some chance of success? By so doing they would be more than likely to prevent the social reformers whose ideals are better than their knowledge of practical possibilities from putting over unworkable schemes that could only end in disaster and tragic disillusionment for pensioners and policy holders. A program that represents the best thought of the real leaders of business should have the best chance for success.

Time Out

TOO MUCH time out has marred many a gridiron contest for even the most rabid rooter. By the same token too much time taken out of the business day to condemn the powers in Washington, and all their works, has marred the sales and operating record of many an industrial executive. One of the hopeful signs of the moment is the tendency of such executives to limit strictly the time taken out to damn the New Deal, and to concentrate on the job of building business and getting orders.

.CHIPS.

Washington—Roosevelt tells press conference that higher prices and narrowing of fluctuations are still his goal, promises evolutionary program and continued conferences with business leaders . . . Farley advocates reduction of ocean mail rates and substitution of direct subsidy to lines . . . Hopkins reports purchase of 1,000,000 acres of marginal lands and transfer of former occupants . . . Roosevelt says informally that he expects to leave enforcement and other judicial features of NRA to Federal Trade Commission and Department of Justice, hopes to have industry do its own policing . . . Committee on Economic Security has eleven sub-committees at work on particular phases of work . . . Decides that government will have to support present unemployed . . . Col. Lindbergh reiterates air mail charges at Aviation Board hearing . . . Sec. Hull gives notice that he will not countenance the raising of tariffs by nations about to negotiate reciprocal agreements with the U. S. . . . Slum clearance and modernization on large scale to be part of recovery scheme proposed to next Congress by Administration.

Foreign—Assassin kills King Alexander of Jugoslavia and Foreign Minister Barthou of France . . . Despite business improvement poor relief costs rise in Great Britain . . . German Protestants jeer Hitler and Mueller, pastors read manifesto defying Nazi bishop . . . France plans to fortify northern frontier facing Belgium . . . Germany serves notice that after one year she will abrogate trade treaty with U. S. containing most-favored-nation clause . . . China puts ten per cent export tax on silver to prevent rise in cost of living, considers going on gold standard . . . "Suicide strike" of Hungarian miners wins increase in pay but at high cost in suffering of men below ground.

Finance—Senate banking committee recommends federal incorporation law to curb holding corporation abuses . . . Treasury closes books on 4th Liberty Loan conversion with over 80 per cent turned in, announces call for $1,870,000,000 more April 15 . . . Germany to pay about 75 per cent of Dawes bond interest . . . In effort to keep money in circulation instead of in the banks, RFC announces plan to extend loans for five years after January 31 . . . Railroad Credit Corporation reports steady repayment of loans to railroads . . . Drive to collect deficiency taxes from corporations is inaugurated . . . Government brings gold bond case to Supreme Court to have act suspending gold payments passed upon.

Industry—Electrical manufacturing industry asks code amendment to raise hours from 36 to 40 and increase hourly wage . . . Union seamen strike on Atlantic seaboard . . . Judge admits evidence of intimidation by unions in Weirton case . . . Personnel Research Federation announces plans for conferences of executives to improve industrial relations . . . A. F. of L. votes to organize vertical unions in mass production industries . . . Roosevelt orders 36-hour week in cotton garment industry . . . P.R.R. shop union joins management in forming mediation board made up of eight from each side, decisions to be made only on two-thirds vote . . . General Motors announces basic policies on employer-employee relations . . . Labor leaders guardedly favorable . . . Three boards created by executive order to study work assignments in branches of textile industry . . . Steel wages up $95,000,000 after year under code, 86 per cent of employees favor works council plans.

Indicators—Steel production declines a little in what is hoped to be a lull before a strong advance . . . Electric power output declines but is ahead of 1933 week . . . Carloadings down . . . *Business Week's* index is practically level at 57.5.

Oils, Machining and Replacement Are Discussed at SAE Production Sessions

The Production Meeting of the Society of Automotive Engineers, held in Detroit October 10 and 11, brought out good evening attendance. Change-over of models for 1935 affected the day sessions.

The paper on cutting oils by W. D. Huffman was discussed at considerable length by C. B. Harding and W. H. Oldacre. Both urged greater cooperation between production men and oil suppliers and a realization of the importance of the subject by those responsible for results. Mr. Harding pointed out that the field for emulsions was increasing and now included blanking, broaching, tapping, milling and gear cutting. He advocated a large volume of coolant under pressure, delivered on the tool itself. The preparation of the emulsion was important and should be in the hands of a responsible party. Distribution methods should also be given careful consideration.

Mr. Oldacre considered emulsions as poor coolants where temperature ran above the boiling point and felt that straight oil was better on jobs of that kind. Sulphurized oils were commended, but it was felt that the term was frequently used without much consideration as to its real meaning. Mr. Bowers pointed out that, while sulphur helped to cool work and tool, it also shortened the life of the tool, especially when used in excess.

In response to a plea for more specific recommendations as to cutting oils for special jobs the oil men agreed that they seldom received enough data as to the job to be done. Feed, speed, depth of cut and material all affect the selection of best lubricant for the job. Greater cooperation will, in their opinion, benefit all concerned.

The paper on balancing problems by T. C. Van Degrift and J. M. Tyler was appreciated but did not elicit wide discussion. Discussion brought out the fact that only the two ends of a crankshaft were balanced as this method gives better control of metal removal and secures good results at low cost. Balancing of V-8 crankshafts was also discussed.

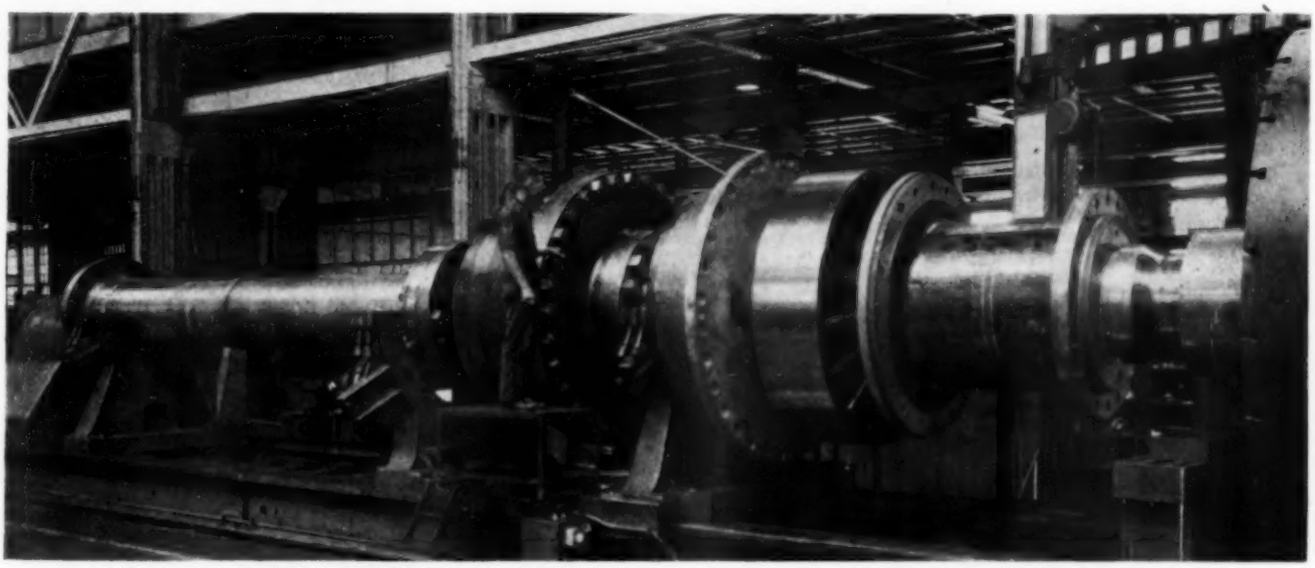
The paper on broaching by E. S. Chapman elicited discussion by R. S. Drummond and others. Mr. Drummond pointed out the increase in cutting speed, stating that 80 ft. per min. was not exceptional in some work. His experience indicated that broach life depended on previous machining operations, on the rigidity of the fixtures and on the broaches themselves. By the use of dial or shuttle holding devices by which the work can be presented to the broach as soon as it completes its return stroke, horizontal machines of old design can be made to give high production. In one case, where the limit was 0.001 in., 500 pieces per hour were secured in this way. Due to improved practice resulting from experience broaches now last three to five times as long as formerly.

Any surface that can be milled, except blind holes, can be broached equally well, where conditions warrant. A special application is the final finish of parts that have been hardened to the point where a file just touches them. By using special broaches with extra hard teeth, such work as finishing splined holes can be handled economically. From 0.003 to 0.004 in. can be removed with a regrind for every 300 holes.

Replying to questions as to broaching cast iron surfaces, W. S. Wise stated that except for hard spots and the abrasive action of cast iron, there was no difficulty and that this also applied to milling. The limits given in Mr. Chapman's paper were much wider than usual, 0.001 in. plus or minus being common.

Machinery and equipment policies were discussed by J. E. Padgett of the Spicer Mfg. Corporation in a somewhat pessimistic vein. Both R. E. W. Harrison and Herman H. Lind took issue with several of his points, giving examples of the advantages of having an equipment policy that set up a reserve for new machinery, and kept this reserve intact instead of using it for dividends, as is sometimes done. Both cited instances of firms whose success came from maintaining equipment on a modern basis, and where such investment paid good dividends.

At the dinner Richard H. Grant, vice-president of General Motors, gave an interesting talk on the sales outlook.



***Giant Generator Shaft*—When completed this main shaft of the world's largest 25-cycle, 35,000 kva. waterwheel generator will be installed in the Safe Harbor power plant on the Susquehanna River. It is shown here being turned on one of the large lathes in the Schenectady Works of the General Electric Co. This plant will serve the newly electrified divisions of the Pennsylvania R.R.**

Machine Tool Orders Again Falter

While September failed to see a continuance of the August pick-up in machine tool sales, the scale of activity was still above the summer low of July and August. A fall of nine per cent in domestic sales under the previous month and an even greater decline in foreign sales brought the index of orders to 36.2 as against 41.4 in August. However, the three months' moving average, which the industry's Supervising Agency uses to indicate the trend, moved up slightly to 37.4 from 37.1 in the previous month.

Foreign orders in September were 19 per cent of the total as compared to 21 per cent in August. The distribution of orders was disappointing with 105 of 175 companies reporting showing less than 30 per cent of the 1926 volume of business. Smaller concerns held up better than the larger ones with a decline in the Group B index to 42.5 from 45.7 whereas the Group A index fell to 35.8 from 41.0.

Foundry Orders Rise in September

With an index of 46.4 in September as against 43.1 in August, and 34.9 in September, 1933, orders for foundry equipment reflected the general improvements in business. Shipments were off during the month with an index of 37.0, which compares with 48.7 in August and 41.5 in September of last year. However, unfilled orders rose sharply to 46.6, contrasted with 36.3 in the preceding month, and 32.0 a year ago. The three months' average of gross orders at 46.7 was exactly the same as that of September for last year, but under the 54.7 reached in August. These figures are based on the reports of 21 companies to the Foundry Equipment Manufacturers' Association.

Table I—Index of Orders, Based on Volume of Shipments for 1926

Month	Index of Orders			3 Months' Average Index	% Foreign to Total Orders
	Domestic	Foreign	Total		
January	43.9	9.8	53.7	56.5	18
February	40.5	10.4	50.9	58.2	20
March	40.1	8.0	48.1	50.9	17
April	36.2	10.3	46.5	48.5	22
May	35.4	10.5	45.9	46.8	23
June	27.4	7.9	35.3	42.6	22
July	26.3	8.4	34.7	38.6	24
August	32.4	9.0	41.4	37.1	21
September	29.4	6.8	36.2	37.4	19

Table II—By Size of Companies

Group A—Companies reporting year's sales in 1926 of $200,000 or more:

Month	Index of Orders			No. of Reports	% Foreign to Total Orders
	Domestic	Foreign	Total		
January	43.5	10.5	54.0	82	19
February	39.5	11.2	50.7	82	22
March	38.8	8.4	47.2	82	18
April	35.3	10.9	46.2	89	24
May	34.6	11.2	45.8	88	25
June	26.8	8.3	35.1	90	24
July	25.8	8.9	34.7	90	26
August	31.4	9.6	41.0	93	23
September	28.7	7.1	35.8	94	20
Group B—Companies reporting year's sales in 1926 of less than $200,000:					
January	48.3	1.5	49.8	81	3
February	50.6	2.4	53.0	81	5
March	54.7	2.6	57.3	81	5
April	48.2	2.1	50.3	74	4
May	46.4	1.6	48.0	72	3
June	33.9	3.5	37.4	76	9
July	33.3	1.9	35.2	82	5
August	44.7	1.0	45.7	76	2
September	39.4	3.1	42.5	81	7

Table III—Distribution of Orders

(Shown by indexes of individual companies)

New Orders in % of 1926 Shipments	Number of Reports in Each Index Group								
	January	February	March	April	May	June	July	August	September
200 or more	7	4	4	6	4	2	3	6	3
100–199	14	16	17	15	12	10	9	8	12
90–99	8	4	5	4	4	0	2	5	2
80–89	7	5	6	3	5	8	3	7	5
70–79	4	4	7	2	6	5	2	3	6
60–69	5	6	12	5	11	10	12	9	2
50–59	5	13	6	19	12	7	8	12	9
40–49	20	14	9	19	10	9	13	14	15
30–39	14	14	19	17	22	24	22	18	16
20–29	22	20	27	20	22	25	29	23	24
10–19	27	25	23	22	33	21	26	27	29
Less than 10	30	38	38	31	19	45	43	37	52
Total reports	163	163	163	163	160	166	172	169	175

Metal-Working Code Hearings Scheduled

Date	Place	Deputy Administrator	Association
Oct. 27	Carlton Hotel	H. F. White	General Tool and Implement (Division of FMPF)

Cincinnati Milling Holds Anniversary Celebration

Visitors to the fiftieth anniversary celebration and exhibit given by the Cincinnati Milling Machine Co. and Cincinnati Grinders, Inc., were royally entertained during the week of October 8-13. Customers, competitors and other friends were shown the manufacturing set-ups of these organizations and the many products made by them. Some of these, which were introduced for the first time, will be described in detail in later numbers of *American Machinist*. Through the courtesy of the Cincinnati companies the Heald Machine Co. was able to include its line of internal grinders and boring machines in the exhibit.

On the afternoon of October 12, a golf tournament was held. That evening 250 guests were entertained at a banquet at the Queen City Country Club. Frederick V. Geir, president of the company, acted as toastmaster. Among the speakers were Mayor Brown of Cincinnati; Dean Schneider, of the University of Cincinnati; Mason Britton, vice-president, McGraw-Hill Publishing Co. and Ralph E. Flanders, president, Jones & Lamson Machine Co. Mr. Flanders' address appears on page 743.

In celebrating its arrival at the half century mark the company paid a tribute to the late Frederick A. Geir, whose leadership was largely responsible for its growth and progress.

Dr. von Schrenk Elected A.S.T.M. President

On October 9, Dr. Hermann von Schrenk, consulting timber engineer and senior vice-president of the American Society for Testing Materials, was elected to the office of president. The executive committee took this action to fill the vacancy caused by the death of W. H. Bassett, who died July 21 soon after he took office as head of the society. The vacancy created by Dr. von Schrenk's election was filled by the appointment of H. S. Vassar as senior vice-president. A. C. Fieldner, chief engineer, experiment stations division, U. S. Bureau of Mines, was elected junior vice-president.

Detroit Cuts Production To Clean Up Old Lines

DETROIT—Members of the Automobile Manufacturers Association, the old N.A.C.C., report production of 113,316 units in September which is 32 per cent under August and 23 per cent below September of last year. With the Ford figures added the output in September will be close to 170,000 as compared with 244,713 for August. September sales are estimated to be close to 150,000 units in this country. The sales figures cannot be subtracted from the production figures to arrive at the additions to stock since the latter include Canadian output and foreign assemblies made from parts produced in the United States. October trend in sales is approximately that of last year when 136,000 passenger cars were sold.

Exports of automotive products in August registered usual seasonal declines, being 16 per cent below July, but gained 90 per cent over August 1933; 14 per cent more trucks, however, were shipped abroad than in July. Truck sales in this country reached a peak in August as compared with the June peak in passenger car sales, which augers well for general business revival.

Government estimates explain the surprising strength of sales in rural area despite the drouth. Farmer income for the first eight months of this year was almost three-quarters of a billion dollars higher than last year, including reduction payments and purchase of drouth cattle. Sales of farm products alone were $465,000,000 greater. Income is expected to reach a peak in September and October.

Many automobile makers are closed, some for inventory and others for plant rearrangement. October consequently is expected to register the low production so far this year. These shut-downs are caused largely by liquidation of dealer stocks to avoid so far as possible drastic price reductions at the expiration of the 1934 models. Stocks are not considered abnormal, and recently production has been running below sales. Hudson Motor stocks are dropping at the rate of 500 per week, which will be accelerated in mid-October with output curtailed and sales holding fairly steady. The same tendency is shown in General Motors business; combined sales to consumers in September exceeded sales to dealers by 18,000 units.

Packard has a large bank of orders for the new model announced August 30, the five-passenger model being the only one the factory has been able to produce in quantities. The orders on hand at the beginning of October will keep the factory busy for two months on one seven-hour shift. Sales in September increased 30 per cent over the same month last year with October looking even better. Buick sales for September were 400 greater than August and over 50 per cent better than the same month last year.

With dealer stocks being reduced and some companies reporting near completion of 1934 supplies, the tooling programs are not of the same proportions as last year. Tool plants, enthusiastic as to prospects the first part of September, are finding that requests for quotations on new tools are not resulting in orders to the extent expected. On the other hand, revamping is practiced as far as possible. The answer most likely is that the fundamental lines of many cars were established in '34, and '35 models will merely be modified to correct car lines. Structural details of bodies are due for some change. The Paris show, on October 1, emphasized the extreme in streamlining while German design of new models featured rear engine mounting in addition to independent wheel suspension and stream lines. A rear engine model in this country as a trial balloon may be expected. In fact, there may be more than one.

Dissatisfaction with the auto retail code as well as that of the machine tool industry accumulates, while it is reported that a permanent NRA set-up is being prepared for congress which eliminates the objectional price fixing features. The Government decision not to carry the Houde case to court is encouraging to those hoping for satisfactory industrial relations. It is dawning on workers that the automotive settlement last March puts a premium on the employee whose service record is unmarred through disturbances. In many cases wage plans have been changed to the straight day rate as a result of managements putting the matter up to the employee vote. The workers in one case agreed that efficiency would be maintained, which was done. Evidences of such cooperation deserve wider publicity for the good of both parties.

• INDUSTRIAL REVIEW •

• Machinery men in all of the important industrial centers report encouraging evidences of a small revival in machinery sales. Whether the improvement is a result of the changed attitude in Washington toward business, fear of inflation or taxation of corporate surpluses, or just a natural reaction from the exaggerated conservatism of the past few months it is hard to say. The main point is that orders are widely distributed and somewhat more numerous, and that inquiries are much stronger.

• Diversification of sources of orders characterizes eastern territory business, particularly in New York. Orders are small but they are coming in daily. Boston and Philadelphia report continued criticism of the New Deal but are looking for Ordnance orders. Sentiment is better in Pittsburgh although orders are at a low for the year. Inquiries are fair. Word from Cleveland is that machinery customers seem to be holding off as long as possible before placing orders. Some business is in sight, however. Although northern New York has suffered from the transfer and liquidation of automobile parts plants, several other plants have been vigorously active. One distributor reports better business in the last month than in any month since 1929.

• Detroit says that the automobile companies have been slower than usual in tooling up for new models. Some of the tool shops are busier, however. Sentiment is much improved and plans are under way for an active spring. Toledo sentiment is still strongly opposed to New Deal policies and forward planning there is suffering in consequence. In Indianapolis the sentiment is optimistic rather than otherwise although sales are quiet. The last quarter promises to be fair. Both inquiries and orders have shown improvement in Cincinnati. The celebration of the Cincinnati Milling Machine Company's 50th anniversary brought many leading buyers to Cincinnati and all shops made the most of it.

• A fair amount of business has been placed in St. Louis during the past fortnight although there was hardly enough to go around. Sentiment is better. Little change is reported from Chicago although there are plenty of prospects who should be buying. Liquidation of the Grigsby-Grunow plant is affecting sales of new machine tools. Milwaukee reports a flock of very encouraging inquiries from diversified sources. The fourth quarter is likely to show some improvement. Word from California is that business is held up pending the result of the election. Possible purchasers of machinery will do nothing until they see whether Sinclair and his EPIC slogan win or whether conservative ideas prevail.

British Machine Tool Industry Holds Up Well

BIRMINGHAM, ENGLAND—The machine tool industry of the Birmingham district shows little evidence of weakening, according to George A. Makinson, American consul, though during the past few weeks the pressure of orders has somewhat lessened because of customary seasonal slackness in the engineering and machinery using trades. The requirements of the automobile industry, one of the principal markets for locally made machine tools, have for some months furnished the main source of activity. Although for the most part the installation of the new season's equipment has not been largely completed, the development of production is expected to stimulate continued demand for machine tools in balancing mechanical systems.

The requirements of the bolt, nut and screw industry have, during the past few months, represented one of the principal sources of local machine tool manufacturing activity. Production in this matter has now been much stimulated by the recently increased British customs duties on a number of various types of bolts, nuts and screws. The local machine tool industry has also shared in the recent demand of the radio trade in respect to next season's production.

The railroads of the country have also been profitable machine tool customers, their shops currently being busier than at any time during the past few years, chiefly in the construction of new locomotives and railroad stock; fair sized orders for railway equipment are also in hand for foreign account.

One of the largest importers of American and other machine tools in this country (Charles Churchill & Company, Ltd.) is now engaged in considerable extension of its existing premises in Birmingham and has acquired a three-acre site for the erection of a centralized headquarters within the city area. The new works will include a testing department, machine tool assembly and demonstration sections, and will provide employment for many additional hands. The firm at present holds exclusive or joint agencies for well over 100 American machine tool manufacturers, and it is understood that its Birmingham works will handle complete servicing and maintenance for the whole of Great Britain.

The floor space of one important Coventry machine tool manufacturer has, within the past few months, been greatly extended in order to cater to a continued increase in the demand for die-heads and dies, chucks, air chucks and similar equipment. The firm proposes to install a continuous conveyor system to accelerate machining operations; upon completion, the capacity of this particular department will be increased to 3,500 sets of dies per week.

During the past few weeks a large Birmingham machine tool firm has taken over extensive new premises and is busily engaged in the manufacture of small three- and four-operation bar automatics and strip rolling mills. In this connection, the firm's recent drilling attachment improvements include spindle speeds up to 12,000 r.p.m.

The demand by domestic machine tool manufacturers for high precision roller bearings has occasioned much overtime working by a local concern associated with an important roller bearing firm in the United States.

Increased activity of the automobile industry has necessitated considerable extensions by an important Birmingham sheet metal pressings manufacturer in order adequately to meet current demands for heavy pressings and steel panel automobile bodies.

Some of the most important recent orders placed with local firms by the automobile industry include drilling and grinding machines of standard and special types, and there has recently been much overtime work in this direction.

The importation of foreign made machine tools continues to increase, the comparative figures for the first seven months of the present year, and similar periods of 1932 and 1933 being as follows:

	Quantities			Value in £		
	Seven months ended July 31					
	1932	1933	1934	1932	1933	1934
Machine tools (metal working) . . .	2,706	1,803	3,512	568,025	414,559	769,554

These importations are stated to be mainly American and German machine tools, the competitive sale of the American products being greatly assisted by the revalued dollar. The continued increase is causing much concern among local manufacturers who, during the period of depreciated sterling currency and the subsequent imposition of British tariffs, enjoyed a virtually undisputed dominance of the home market.

At a recent meeting of the Wolverhampton Chamber of Commerce a plea for "stiff increases in certain tariffs" was put forward, it being stated that "many British firms who had spent large sums on modernizing their plants were now finding themselves in direct competition with German and American goods again."

In addition to the present favorable dollar-sterling exchange rate, it is stated by one important local firm that recent prices of the principal classes of American machine tools have tended to depreciate, and this, coupled with the undoubted superiority of American products has afforded some stmulus to the volume of importation within the past few months.

Furthermore, contrary to the usual practice of British manufacturers, many types of American made machine tools are stated to have the advantages of immediate delivery from stock, a facility which is greatly appreciated by local machine tool using firms desiring to engage in immediate productive activity.

Exports of Machine Tools

The exportation of British made metal-working machine tools is being well maintained. During the past few years the requirements of Soviet Russia in respect of drilling, grinding and milling machines; lathes, planing and shaping machines; presses and punching and shearing machines, have formed the bulk of this trade, the year 1932 showing the greatest amount of British exportation to that country, amounting to over 80 per cent of the total. However, since this period, Russian machine tool orders have shown a declining ratio largely on account of the culmination of the five-year plan. On the other hand, there has been increased exportation to other foreign markets including the Far East, Argentina, France, Norway and Sweden, Italy and other European countries. Machine tool export trade with the British dominions has also shown much improvement.

Comparative figures of British machine tool exportation for the first seven months of the years 1932, 1933 and 1934, are given in the accompanying table.

Outlook for American Tools

In spite of the fact that an appreciably greater number of American machine tools are being imported into Great Britain at the present time, and are being increasingly used in local machine shop processes, the existing market is almost wholly limited to specialized products. For the more or-

British Exports of Machine Tools

Machine Tools (metal working)	1932	1933	1934
	—Seven Months ended July 31—		
	£	£	£
To British India	89,153	78,419	86,136
" Other British countries	72,670	77,638	182,527
" Soviet Union (Russia)	1,714,800	526,167	264,477
" France	42,739	32,026	40,148
" Other Foreign Countries	130,658	158,679	279,710
Total	2,050,020	873,929	852,998
Of which—			
Drilling	317,574	79,627	78,776
Grinding	256,794	213,196	147,991
Lathes	610,194	240,627	269,310
Milling	152,101	110,848	63,346
Planing and Shaping	338,717	23,635	43,774

dinarily used machine tools, such as lathes, power saws, chucks, planers, shapers, and similar standard machines, British manufacturers still hold the dominance which they acquired through factors of sterling depreciation and import duties; while the manufacture in this country, on a royalty or other basis, of numerous American machine tools which were formerly imported, greatly restricts the competitive British market for similar products which are still wholly made in the United States.

It also appears that, due to existing industrial conditions in the United States, an increasing quantity of used machine tools is now being imported into Great Britain from that country virtually at scrap prices, with a consequent effect upon the domestic market for new products of both British and American manufacture.

German Machine Tool Industry Shows Improvement

With operations well over 50 per cent of capacity during a usually dull season the machine tool industry in Germany shows considerable improvement over the corresponding period of 1933. Medium and heavy-weight machinery in particular is showing a gain, according to a report from the Department of Commerce.

The improvements have resulted almost entirely from increased domestic sales, as exports of German machine tools continue low. Demands from the steel industry have been larger in recent months which was the principal factor in the improvement of trade in the west-German machine tool industry.

Trade in woodworking machinery reflected the usual seasonal decline and mining machinery was not entirely satisfactory. However the demand from the automobile industry increased, and there was some improvement in orders from shipyards and from the electrical industry.

Tax exemptions for machinery replacements reacted favorably on the trade. Sales were higher in high efficiency machine tools, including lathes and machinery for handling steel and foundry products, and tube mill machinery.

J. R. Porter Heads Dealers Supervisory Agency

J. Roy Porter, president and general manager of the Marshall & Huschart Machinery Co., has been elected chairman of the Supervisory Agency which administers the NRA code of the distributors of machine tools and equipment. The retiring chairman, George H. Cherrington, president of the Brown & Zortman Machinery Co., whose term would not have expired until December, was compelled to resign because of his health.

Ambrose Swasey Honored

At a dinner celebrating the 20th anniversary of the Engineering Foundation, Ambrose Swasey, chairman of the board of directors of the Warner & Swasey Co., was honored. Mr. Swasey, a noted inventor and maker of astronomical instruments and machine tools, is founder of the foundation and has made its activities possible to gifts totaling $750,000. He is also a past president of the American Society of Mechanical Engineers and Chevalier of the Legion of Honor.

Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, made the principal address, in which he appealed for the support by other men of wealth for foundations and educational agencies, working toward the betterment of human welfare. Dr. Frank B. Jewett, vice-president of the American Telephone and Telegraph Co., said that religion, institutions of learning and foundations like the Engineering Foundation comprise three of the most vital forces in modern culture. A volume expressing felicitation and gratitude was presented to Mr. Swasey by Harry P. Charlesworth, chairman of the Engineering Foundation.

• BUSINESS ITEMS •

Final arrangements have been made by the General Electric Company to inaugurate the manufacture of radio receivers at its Bridgeport, Conn., works. Production is scheduled to start the first of the year. Preparations are now going forward for the completion of manufacturing equipment which will occupy several floors of the main building.

The Shepard Niles Crane & Hoist Corp. has now concentrated all of its manufacturing divisions at Montour Falls, N. Y. The Niles plant in Philadelphia has been closed. A new erecting shop designed for the manufacture of Niles heavy cranes has been built. The plant formerly occupied by Cronk & Carrier Manufacturing Co., at Montour Falls, and which adjoins the Shepard plant, has been purchased and affords additional space required by the above concentration of activities.

The Geo. D. Roper Corp., Rockford, Ill., has filed a petition under the Corporate Reorganization Amendment, Section 77-B of the Bankruptcy Act, this being the amendment to that Act adopted at the last session of Congress to aid corporate reorganizations without interrupting operations.

Bryant Machinery & Engineering Co., Chicago, has appointed Frank D. Lake & Associates, 3024 Cherry St., Toledo, Ohio, as agents for the following lines of machine tools: Ohio shapers, Dreses radial drills, Ohio horizontal boring, drilling and milling machines, Boye & Emmes engine lathes, Cleereman heavy-duty drilling machines and Kling heavy-duty grinders.

George D. Miller Co., machine tool dealer, Cleveland, Ohio, has been appointed exclusive representative in the Cleveland territory for the Lees-Bradner Company, manufacturers of gear hobbers, generators, thead milling machines and gear testing machines.

Thomas Prosser & Son, New York, N. Y., manufacturers and distributors of Widia carbide tools, have made the following sales appointments: J. J. Connell, 4717 Malden Ave., Chicago; W.

Corporation Reports

Company	1934 Earnings Third Quarter	1934 Earnings Nine Months	1933 Earnings Third Quarter	1933 Earnings Nine Months
Caterpillar Tractor		$ 2,932,892		d$304,364
S. R. Dresser		$ 82,048		$45,547
Gabriel	$1,003	d$29,295	$5,630	d$2,812
General Electric		$11,714,247		$6,886,600
National Cash Register.	$226,804	$ 1,229,751	d$242,134	d$841,907
Remington Rand	$224,573	*$389,600	$203,656	*$109,566
Scovill Mfg.		†$493,426		
Underwood-Elliot-Fisher.	$458,046	$ 1,850,137	$539,954	$840,056

d—Deficit.
*—Six months ended Sept. 30.
†—Seven months ended July 31.

D. BRIGGS, P. O. Box 315, Portland, Ind., and G. M. MENCKE, 704 Race St., Cincinnati, Ohio. These men will represent Thomas Prosser & Son for rolling mill machinery and metal specialties manufactured by Fried. Krupp A.G.

The Allsteel Press Co., Chicago, Ill., has appointed the Mechanical Equipment Sales Co., 416 Chamber of Commerce Bldg., Cincinnati, Ohio, as representative in that district.

• PERSONALS •

CLAUDE A. STEADMAN has become associated with the Pioneer Engineering & Mfg. Co., Detroit, designers of tools, dies and gages and special machinery. Mr. Steadman was formerly with various motor companies as tool and die engineer, and for the last five years was chief tool designer for the Wright Aeronautical Corp.

V. G. VAUGHAN has been made manager of the Spencer Thermostat Co., Attleboro, Mass., and will develop automatic temperature and humidity controls. Until June of this year Mr. Vaughan was manager of the Appliance Engineering Division, Westinghouse Electric & Manufacturing Company.

HARRY WEART, has been appointed assistant works manager of Goulds Pumps, Inc., Seneca Falls, N. Y. Previously he was development engineer.

FREDERICK E. WORDEN of Auburn, N. Y., and WOLCOTT J. HUMPHREY of Warsaw, N. Y., have been appointed temporary receivers of the Rumsey Pump, Co., Ltd., Seneca Falls, N. Y., and have been authorized to continue operation of the plant.

• OBITUARIES •

R. Y. FERNER, president of the R. Y. Ferner Co., Washington, D. C., importer of precision machinery and scientific instruments, principally of the Societe Genevoise D'Instruments de Physique, Geneva, Switzerland, died from a heart attack on October 7.

WILLIAM A. KIRBY in charge of the Fleetwood Division, The Fisher Body Corp., Detroit, died October 3 at the age of 56.

JAMES M. RAWLE, vice-president of the J. G. Brill Co., Philadelphia, died October 4.

• MEETINGS •

AMERICAN GAS ASSOCIATION. Sixteenth annual convention, October 29-November 2. Atlantic City Auditorium, Atlantic City, N. J. ALEXANDER FORWARD, managing director, 420 Lexington Ave., New York, N. Y.

AMERICAN FOUNDRYMEN'S ASSOCIATION. International foundry congress and annual meeting and exposition, Oct. 22-26. Convention Hall, Philadelphia. R. E. KENNEDY, technical secretary, 222 W. Adams St., Chicago, Ill.

INTERNATIONAL ACETYLENE ASSOCIATION. Annual meeting, Nov. 14-16. William Penn Hotel, Pittsburgh, Pa. H. F. REINHARD, secretary, 30 East 42nd St., New York, N. Y.

• PATENTS •

September 18, 1934

Metal-Working Machinery

Combination Thread or Spiral Miller. Albert Saroosy, West Orange, N. J., assigned to Layth-Grindar Corp. Patent 1,974,084.

Tap Grinding Machine. Edd C. Oliver, Adrian, Mich. Patent 1,974,365.

Tools and Attachments

Tool Retainer. Clement C. Richard, Detroit, Mich., assigned to Allied Products Corp. Patent 1,974,217.

Motor-Operated Chuck. Charles W. Olson, Cleveland Heights, Ohio. Patent 1,974,249.

Chuck Controller Device. Lucius E. Whiton, New London, Conn. Patent 1,974,384.

Chuck Controlling Mechanism. Lucius E. Whiton, New London, Conn. Patent 1,974,385.

September 25, 1934

Metal-Working Machinery

Conveyor Feed Milling Machine. William Sinclair, Detroit, Mich., assigned to Production Engineering Co. Patent 1,974,660.

Grinding Machine. Oscar A. Swanson, Erie, Pa. Patent 1,974,696.

Indexing and Control Mechanism for a Metal Working Machine. Edward J. Kingsbury and Gunnar Swahnberg, Keene, N. H., assigned to Kingsbury Machine Tool Corp. Patent 1,975,005.

Indexing and Control Mechanism for Independent Metal Working Units. Edward J. Kingsbury and Gunnar Swahnberg, Keene, N. H., assigned to Kingsbury Machine Tool Corp. Patent 1,975,006.

Metal Working Machine. Edward J. Kingsbury, Keene, N. H. Patent 1,975,007.

Machine Tool Having an Indexing Movement. Edward J. Kingsbury, Keene, N. H., assigned to Kingsbury Machine Tool Corp. Patent 1,975,008.

October 2, 1934

Metal-Working Machinery

Chamfering Mechanism. Maxwell H. Hill, Rochester, N. Y., assigned to Gleason Works. Patent 1,975,151.

Forging Machine. William W. Criley, Cleveland, O. Patent 1,975,537.

Centralized Hydraulic Control for Radial Drills. Lawrence Lee Schauer and Augustus Marius Sosa, Cincinnati, Ohio, assigned to the Cincinnati Bickford Tool Co. Patent 1,975,589.

October 9, 1934

Metal-Working Machinery

Machine Tool. Edgar D. Vancil, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,975,912.

Machine Tool. Herman R. Isler and Sol Einstein, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,975,947.

Grinding Machine. Benjamin R. Purvin, Cleveland, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,035.

Method and Means for Preventing Chattering of Slender Work. Wilson F. Howard, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,976,072.

Milling Machinery. Walter D. Archea, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,976,104-5-6-7-8.

Grinding Machine. Walter D. Archea, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,109.

Grinding Machine. George W. Binns, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,110.

Machine Tool. George W. Binns and Clement Booth, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,111.

Grinding Machine. George W. Binns, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,112.

Machine Tool. George W. Binns, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,113.

Grinding Machine. Clement Booth, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,114.

Grinding Machine. Sol Einstein, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,119.

Hydraulic Drive for Grinding Machines. Frederick S. Haas, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,122.

Grinding Machinery. Frederick S. Haas, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,123.

Grinding Machine. Bernard A. Kearns and Frederick S. Haas, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,976,130.

Milling Machine. Lester F. Nenninger, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,976,136.

Hydraulically Actuated Slide for Machine Tools. Lester F. Nenninger, and Bernard Sassen, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,976,137.

Back Lash Compensator. Lester F. Nenninger, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,976,138.

Milling Machine. Lester F. Nenninger and Bernard Sassen, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,976,139.

Machine for Beading Over Sheet Metal Flanges. Xaver Sonntag, Reute, near Waldsee, Germany. Patent 1,976,148.

Transmission and Control Mechanism for Machine Tools. Fred A. Parsons, Milwaukee, Wis., assigned to Kearney & Trecker Corp. Patent 1,976,368.

Milling Machine Transmission and Control. Joseph B. Armitage, Wauwatosa, Wis., assigned to Kearney & Trecker Corp. Patent 1,976,381.

Chaser-Cutting Mechanism. Albert F. Breitenstein, New Haven, Conn., assigned to the Geometric Tool Co. Patent 1,976,476.

Processes

Process for Rough Turning in the Lathe or Similar Machine Tool. Paul Quichon, Paris, France, assigned to Compagnie des Forges de Chatillon Commentry & Neuvres-Maisons, Paris, France. Patent 1,976,459.

American Machinist

REFERENCE BOOK SHEET

©

Trade Designations of Aluminum Alloys

Abstracted from "Service Characteristics of the Light Metals and Their Alloys," published by the American Society for Testing Materials.

MECHANICAL PROPERTIES OF ALUMINUM WROUGHT ALLOYS.[a]

Modulus of elasticity is 10,000,000 lb. per sq. in.

Item	Temper[b]	Material Tested	Tensile Strength, lb. per sq. in.	Yield Strength (Set = 0.2 per cent), lb. per sq. in.[c]	Elongation in 2 in., per cent	Brinell Hardness Number[d]	Rockwell Hardness Numbers[e]	Shearing Strength, lb. per sq. in.[f]	Endurance Limit, lb. per sq. in.[g]
No. 1	O	Rod	13 000	4 000	40	23	B-43	9 500	5 000
	¼H		17 000	14 000	20	32	B-72	11 000	7 000
	½H		24 000	21 000	10	44	B-85	13 000	8 500
	¾H		16 000	5 000	40	28	B-52	11 000	7 000
	H		21 000	18 000	20	40	B-61	14 000	9 000
No. 2	O	Rod	20 000	10 000	30	35	B-48	16 000	10 000
	¼H		25 000	21 000	20	45	B-51	16 000	14 000
	½H		31 000	25 000	10	60	B-77	19 000	15 000
	¾H		38 000	31 000	5	65	B-88	22 000	16 000
	H		42 000	38 000	3	80	B-95	18 000	10 500
No. 3	O	Rod	27 000	11 000	23	44	B-51	18 000	15 000
	W		62 000	38 500	25	105	B-98	40 500	15 000
	T		60 000	33 000	18	125	B-104	44 500	15 500
	O	Sheet	28 000	10 000	20	45	B-54	18 000	11 000
	T	Sheet	58 000	35 000	20	100	B-96	35 000	18 000
	RT	Aleclad T	53 000	46 000	13	110	B-98	36 000	.....
	Aleclad RT	Aleclad RT	55 000	40 000	11	...	...	32 000	.....
No. 4	O	Rod	22 000	8 000	22	38	B-37	13 000	13 500
	T		40 000	22 000	22	70	B-79	25 000	.....
No. 5	O	Rod	22 000	8 000	23	38	B-37	13 000	13 000
	T		48 000	25 000	20	85	B-87	29 000	.....
No. 6	O	Rod	28 000	12 000	18	48	B-44	19 000	13 500
	T		62 000	52 000	10	118	B-100	37 000	.....
	O	Sheet	62 000	31 000	20	91	B-92	34 000	.....
	T	Sheet	64 000	36 000	10	100	...	...	.....
	RT	Aleclad T	57 000	43 000	20	103	B-97	40 000	14 000
	Aleclad RT	Aleclad RT	60 000	40 000	18	116	B-99	41 000	14 500
No. 7	O	Rod	48 000	24 000	14	95	B-73	24 000	10 500
	T		62 000	49 000	11	...	...	39 000	.....
No. 8	O	Rod	48 000	24 000	14	95	B-73	22 000	10 500
	T		62 000	49 000	11	...	...	39 000	.....
No. 9	O	Sheet	28 000	10 000	20	45	B-54	18 000	9 000
	H	Sheet	32 000	25 000	8	65	B-67	29 000	14 500
	WT		58 000	35 000	20	100	B-96	35 000	15 000
	T		60 000	43 000	6	98	B-94	38 000	14 000
No. 10	O	Rod	33 000	14 000	24	65	B-73	24 000	10 500
	T		48 000	38 000	14	95	B-92	22 000	10 500
No. 11	O	Sheet	28 000	10 000	20	45	B-54	18 000	9 000
	H	Sheet	32 000	25 000	8	65	B-67	29 000	14 500
	WT		58 000	35 000	20	100	B-96	35 000	15 000
	T		60 000	43 000	6	98	B-94	38 000	14 000
No. 12	O	Rod	33 000	14 000	24	65	B-73	24 000	11 000
No. 13	T	Rod	48 000	38 000	14	95	B-92	22 000	21 000[h]
No. 14	O	Sheet	28 000	10 000	20	45	B-54	18 000	.....
	H	Sheet	32 000	25 000	8	65	B-67	29 000	.....
	WT		58 000	35 000	20	100	B-96	35 000	.....
	T		60 000	43 000	6	98	B-94	38 000	.....
No. 15	O	Rod	33 000	14 000	24	65	B-73	24 000	.....
No. 16	T	Rod	48 000	38 000	14	95	B-92	22 000	.....
No. 17	O	Sheet	28 000	10 000	20	45	B-54	18 000	.....
	H	Sheet	32 000	25 000	8	65	B-67	29 000	.....
	WT		58 000	35 000	20	100	B-96	35 000	.....
	T		60 000	43 000	6	98	B-94	38 000	.....
No. 18	O	Rod	33 000	14 000	24	65	B-73	24 000	.....
	T	Rod	48 000	38 000	14	95	B-92	22 000	.....
No. 19	O	Sheet	17 000	6 000	26	...	B-60	...	.....
	H		22 000	20 500	8	...	B-80	...	.....
	CO		34 500	32 500	4	...	B-88	...	.....
	D5S		40 000	32 000	26	...	B-73	...	.....
	M'O		23 500	11 500	13	...	B-71	...	.....
	CO		44 500	27 000	20	...	B-83	...	.....
	D2018		57 000	48 500	21	...	B-84	...	.....
	D4418		58 500	44 000	10	...	E-102	...	.....
	D5S	Rod	55 000	42 000	17	...	E-104	...	.....

[a] Tension test results obtained on standard A.S.T.M. ½-in. diameter specimens except where noted as sheet (⅛ in. thick) specimens.

[b] O = Annealed.
¼H = Half hard.
H = Hard.
2 = Intermediate temper.
D 2018 or D 2012 = Heat treated, rolled and aged.
D 4418 or D 6418 = Heat treated, rolled, aged and rolled.
W or CO = Solution heat treated.
T or DO = Heat treated and aged.
RT = Heat treated, aged and cold rolled.
MO = Heat treatable.

[c] Yield strength in compression is practically the same as in tension.

[d] 500-kg. load on 10-mm. ball.

[e] B = 60-kg. major load on ½-in. ball; E = 100-kg. major load on ½-in. ball.

[f] Single shear values from double shear tests.

[g] R. R. Moore type rotating-beam machine; 500,000,000 cycles.

[h] Estimated from incomplete results.

TRADE DESIGNATIONS OF ALUMINUM WROUGHT ALLOYS.

Item	A.S.T.M.	S.A.E.	U. S. Army	U. S. Navy[a]	Federal Specifications Board	Aluminum Company of America	The Nicrals-min Co. (Nicral)	Apex Smelting Co.
No. 1	[c]	No. 78 (25)	57-151-1	47A2a 46A3b 44T19 47A4c 46A6a 44T20a	QQ-A-561 QQ-A-411 WW-T-783 QQ-A-359 QQ-A-356 WW-T-788	25	.....	.....
No. 2	[d]	No. 29	.....	47A7 44T24 47A9 46A8	.....	35	.....	.....
No. 3	.....	.....	Air corps 11069	.....	.....	45	.....	.....
No. 4	.....	No. 26	57-153	47A5a 46A4b	QQ-A-355 QQ-A-351	145 175	.....	.....
No. 5	[d]	.....	57-187-2 57-183-2	47T21 47A6a 46A16 44T21a 44T22 46A7a 43B5 43B13	WW-T-786	Alclad 175	.....	.....
No. 6	.....	.....	.....	.....	.....	A 175 B 175 C 175	.....	.....
No. 7	.....	.....	.....	.....	.....	185	.....	.....
No. 8	.....	.....	.....	.....	.....	245	.....	.....
No. 9	.....	No. 24	Air corps 11066 Air corps 11067	47A10 47A8	.....	Alclad 245	.....	.....
No. 10	.....	.....	and 11071	.....	.....	.....	.....	460
No. 11	.....	No. 27	57-193	46A7a	.....	295	.....	.....
No. 12	.....	.....	.....	.....	.....	325	.....	.....
No. 13	.....	No. 28	.....	.....	.....	518	.....	.....
No. 14	.....	.....	.....	.....	.....	538	.....	.....
No. 15	.....	No. 24	Air corps 11066	47A10	.....	708	.....	.....
No. 16	.....	.....	Air corps 11067	47A8	.....	245	.....	.....
No. 17	.....	.....	and 11071	.....	.....	Alclad 245	.....	460
No. 18	.....	.....	57-193	46A7a	.....	295	.....	.....
No. 19	.....	.....	.....	.....	.....	325	A B X	.....

[a] Tentative Specifications for Aluminum Sheet and Plate (B 25 - 33 T), *Proceedings*, Am. Soc. Testing Mats., Vol. 33, Part I, p. 605 (1933); also 1933 Book of A.S.T.M. Tentative Standards, p. 199.

[b] Tentative Specifications for Aluminum-Manganese Alloy Sheet and Plate (B 79 - 33 T), *Proceedings*, Am. Soc. Testing Mats., Vol. 33, Part I, p. 614 (1933); also 1933 Book of A.S.T.M. Tentative Standards, p. 206.

[c] Tentative Specifications for Aluminum-Alloy (Duralumin) Sheet and Plate (Aluminum-Copper-Magnesium-Manganese) (B 78 - 33 T), *Proceedings*, Am. Soc. Testing Mats., Vol. 33, Part I, p. 610 (1933); also 1933 Book of A.S.T.M. Tentative Standards, p. 204.

[d] Tentative Specifications for Aluminum-Alloy (Duralumin) Bars, Rods and Shapes (Aluminum-Copper-Magnesium-Manganese) (B 89 - 33 T), *Proceedings*, Am. Soc. Testing Mats., Vol. 33, Part I, p. 600 (1933); also 1933 Book of A.S.T.M. Tentative Standards, p. 194.

[e] In addition to the specifications listed, several Navy Bureau have tentative specifications.

NOMINAL COMPOSITION OF ALUMINUM WROUGHT ALLOYS.[a]

Item	Silicon, per cent	Manganese, per cent	Copper, per cent	Nickel, per cent	Zinc, per cent	Magnesium, per cent	Other Elements, per cent
			99 per cent aluminum aluminum				
No. 1	.....	1.25	...	...	...	1.0	...
No. 2	.....	1.25	...	...	...	1.0	...
No. 3	0.6	0.75	4.4	...	...	0.35	...
No. 4	0.6	0.6	4.0	...	...	0.5	...
No. 5	.....	...	2.5	...	...	0.3	...
No. 6	.....	...	4.0	...	...	0.5	...
No. 7	1.25	0.6	4.0	...	...	0.5	...
No. 8	.....	0.6	4.0	2.0	...	0.5	...
No. 9	.....	0.6	4.2	...	...	1.5	...
No. 10	0.6	0.6	4.2	...	...	...	...
No. 11	0.6	0.6	4.2	0.6	...	1.0	...
No. 12	12.0	...	...	...	...	...	...
No. 13	1.0	...	...	...	...	1.0	...
No. 14	0.7	...	...	...	...	0.6	...
No. 15	...	0.7	1.0	...	10.0	1.25	Chromium 0.25
No. 16	...	0.5	...	...	...	0.4	...
No. 17	.....	...	0.6	1.0	...	0.8	...
No. 18	.....	...	0.25	0.5	...	0.5	0.3[b]
No. 19	.....	...	1.0	1.0	1.0	0.75	0.3[b]

[a] Aluminum content = remainder.

[b] These alloys contain chromium, manganese and molybdenum in about equal amounts; the sum of the three is shown; magnesium may be omitted.

American Machinist — REFERENCE BOOK SHEET ©

Trade Designations of Aluminum Alloys

Abstracted from "Service Characteristics of the Light Metals and Their Alloys," published by the American Society for Testing Materials.

Fabricating Characteristics of Aluminum Wrought Alloys

Item	Welding[a]		Machining	Polishing and Buffing	Heat Treatment[d]		Mechanical Working[e]					
									Ease of Working			
	Gas	Electric Arc			deg. Fahr.	deg. Cent.	Operation	Temperature	Annealed	Half Hard	Hard	Heat Treated
Nos. 1 to 3	Yes	Yes	Good[c]	Good	Anneal[d]	Anneal[d]	Drawing	Cold	Excellent	Good	Fair	....
No. 4	b	Yes	Good[c]	Good	920–940	495–505	Drawing	"	.....	....	...	Good
No. 5	b	Yes	Good[c]	Good	930–950	500–510	Drawing	"	.....	....	...	Good
No. 6	b	Yes	Good[c]	Good	930–950	500–510	Drawing	"	.....	....	...	Good
No. 7	b	Yes	Good[c]	Good	930–950	500–510	Drawing	"	.....	....	...	Good
No. 8	b	Yes	Good[c]	Good	920–940[f]	495–505[f]	Drawing	"	.....	....	...	Good
No. 9	b	Yes	Good[c]	Good	950–970	510–520	Forging	Hot	.....	....	...	Good
No. 10	b	Yes	Good[c]	Good	910–930	490–500	Drawing	"	.....	....	...	Good
No. 11	b	Yes	Good[c]	Good	960–980[g]	515–525[g]	Forging	Hot	.....	....	...	Good
No. 12	b	Yes	Good[c]	Good	950–970	510–520	Forging	Hot	.....	....	...	Good
No. 13	b	Yes	Good[c]	Good	960–980[f]	515–525[f]	Drawing	"	.....	....	...	Good
No. 14	Yes	Yes	Good[c]	Good	960–980[f]	515–525[f]	Drawing	"	.....	....	...	Good
No. 15	b	Yes	Good[c]	Good	870–890	465–475	Forging	Hot	.....	....	...	Good
No. 16	Yes	Yes	Good[c]	Good	None	None	.....	....	.....	....	...	....
Nos. 17 to 19	Yes	Yes	Good[c]	Good	940–960[h]	505–515[h]	Drawing	"	.....	....	...	Very Good

[a] For details, consult manufacturer.
[b] Gas welding these alloys generally not recommended.
[c] With proper tools.
[d] Alloy 1 anneals at 650 F. (345 C.); 2 and 3 at 750 F. (400 C.).
[e] Age 8 to 15 hours at 290 F. (145 C.) for maximum strength.
[f] Age 18 hours at 320 F. (160 C.) for maximum strength.
[g] Hot or cold depending on job.
[h] May be aged 8 to 24 hours at 290 to 310 F. (145 to 155 C.).

Trade Designations of Aluminum Casting Alloys

Item	A.S.T.M.	S.A.E.	U. S. Army	U. S. Navy	Aluminum Company of America	Stewart Die Casting Corp.
No. 1	.....	No. 30	57-72 grade 5	.....	No. 12	.....
No. 2	.....	No. 31	.....	.....	.....	.....
No. 3	.....	No. 31A	57-72 grade 8	.....	No. 645	.....
No. 4	Grade B[a]	No. 36	.....	.....	No. 212	.....
No. 5	Grade C[a]	No. 33	57-72 grade 7	.....	No. 112	.....
No. 6	Grade E[a]	No. 32	.....	.....	No. 109	.....
No. 7	Grade F[a]	No. 34	57-72 grade 6	.....	No. 122	.....
No. 8	Grade G[a]	No. 38	57-72-5	46A1c class 4	No. 195	.....
No. 9	Grade GG[a]	.....	.....	.....	No. 196	.....
No. 10	Grade H[a]	No. 39	57-72-1A	.....	No. 142	.....
No. 11	Grade J[a]	No. 35	57-72 grade 1	46A1c class 2	No. 43	.....
	No. IV[b]	No. 304	57-93-1	.....	No. 43	No. 35
No. 12	Grade K[a]	No. 37	.....	.....	No. 47	.....
	No. V[b]	No. 305	.....	.....	No. 13	No. 13
No. 13	.....	No. 320	57-74-4	.....	No. 214	.....
No. 14	.....	No. 321	.....	.....	No. 132	.....
No. 15	.....	No. 322	Air Corps 11307	.....	No. 355	.....
No. 16	.....	No. 323	Air Corps 11308	46A1c class 3	No. 356	.....
No. 17	.....	No. 324	.....	.....	No. 220	.....
No. 18	No. VI[b]	.....	.....	.....	No. 43	.....
No. 19	No. VII[b]	No. 307	.....	.....	No. 86	No. 10
No. 20	No. VIII[b]	.....	.....	.....	.....	.....
No. 21	No. IX[b]	No. 309	.....	.....	No. 95	No. 5
No. 22	No. XII[b]	No. 312	57-93	.....	No. 81	No. 12

[a] Classified according to the Tentative Specifications for Aluminum-Base Alloy Sand Castings (B 26 – 33 T), *Proceedings*, Am. Soc. Testing Mats., Vol. 33, Part I, p. 595 (1933); also 1933 Book of A.S.T.M. Tentative Standards, p. 189.
[b] Classified according to the Tentative Specifications for Aluminum-Base Alloy Die Castings (B 85 – 33 T), *Proceedings*, Am. Soc. Testing Mats., Vol. 33, Part I, p. 641 (1933); also 1933 Book of A.S.T.M. Tentative Standards, p. 254.

Typical Mechanical Properties of Aluminum Casting Alloys.[a]

Modulus of elasticity is 10,000,000 lb. per sq. in.

Item	Temper[b]	Tensile Strength, lb. per sq. in.	Yield Strength (Set = 0.2 per cent), lb. per sq. in.	Elongation in 2 in., per cent	Brinell Hardness Number[c]	Shearing Strength, lb. per sq. in.	Charpy Impact, ft-lb.[d]	Compressive Strength, lb. per sq. in.[e]	Endurance Limit, lb. per sq. in.[f]	Density
No. 1	AC	22 000	14 000	2.0	65	20 000	0.70	38 000	7 500	0.102
No. 2	AC	25 000	.....	1.0	.....	.....	.....	.....	.....	.....
No. 3	AC	29 000	22 000	4.0	70	22 500	2.00	50 000	7 500	0.106
No. 4	AC	22 000	14 000	2.0	65	20 000	0.70	38 000	7 500	0.102
No. 5	AC	22 000	14 000	2.0	70	20 000	0.59	44 000	8 500	0.103
No. 6	AC	24 000	18 000	1.5	75	20 000	0.63	45 000	10 000	0.105
No. 7	HT-A	36 000	30 000	1.0	100	29 500	0.68	80 000	.....	0.103
No. 8	HT	31 000	16 000	8.0	65	27 000	2.86	43 000	6 000	0.100
	HT-A	36 000	22 000	4.0	80	29 000	1.80	43 000	6 000	0.100
No. 9	HT-A	38 000	34 000	1.0	100	34 000	1.81	64 000	6 500	0.100
No. 10	AC	28 000	24 000	1.0	85	24 000	0.62	52 000	8 000	0.100
	HT-A	37 000	.....	0.5	100	32 000	0.59	70 000	8 000	0.100
No. 11	AC	19 000	9 000	4.0	40	15 000	0.98	25 000	6 500	0.096
	AC*	29 000	12 000	3.5	.....	.....	4.50	.....	.....	.....
No. 12	Modified	26 000	11 000	8.0	50	18 000	3.00	28 000	6 000	0.095
	AC*	33 000	16 000	1.5	80	.....	2.00	.....	.....	.....
No. 13	AC	25 000	12 000	9.0	50	19 000	3.80	50 000	5 500	0.095
No. 14	HT-A	.....	.....	.....	.....	.....	.....	.....	.....	.....
No. 15	HT	30 000	20 000	4.0	60	30 000	1.26	65 000	.....	0.097
	HT-A	35 000	27 000	2.0	80	30 000	1.08	68 000	.....	0.097
No. 16	HT	28 000	16 000	6.0	55	22 000	1.65	46 000	.....	0.095
	HT-A	32 000	22 000	4.0	70	23 000	1.00	48 000	8 000	0.095
No. 17	HT	44 000	26 000	13.0	75	33 500	4.50	72 500	7 500	0.092
No. 18	AC*	30 000	13 000	3.5	100	.....	5.00	.....	.....	.....
No. 19	AC*	32 000	18 000	2.0	60	.....	2.50	.....	.....	.....
No. 20	AC*	29 000	.....	4.0	.....	.....	4.50	.....	.....	.....
No. 21	AC*	21 000	19 000	1.5	80	.....	2.00	.....	.....	.....
No. 22	AC*	33 000	25 000	1.0	80	.....	1.50	.....	.....	.....

[a] Tension test results obtained on standard ½-in. diameter, sand-cast bars except where marked with an asterisk (*) in "temper" column, in which case they were ½-in. diameter die-cast bars.
[b] AC = as cast; HT = heat treated; HT-A = heat treated and aged.
[c] 500-kg. load, 10-mm. ball.
[d] The Charpy impact values for sand castings are from bars 10 mm. square and having a noted 5 mm. deep with a 1 mm. radius at the bottom; for die castings, a ½-in. square bar, 3 in. long and with a notch, was used.
[e] Specimens having l/r ratio of 16 to 20. All failed by lateral bending.
[f] R.R. Moore type machine — 500,000,000 cycles.

Nominal Composition of Aluminum Casting Alloys.[a]

Item	Copper, per cent	Silicon, per cent	Magnesium, per cent	Zinc, per cent	Nickel, per cent	Iron, per cent
No. 1	8.0	....	....	....	...	....
No. 2	2.7	....	....	13.5	....	....
No. 3	2.5	....	....	11.0	....	1.5
No. 4	7.7	1.2	....	....	....	1.0
No. 5	7.0	2.0	....	2.0	....	1.2
No. 6	12.0	....	....	....	....	....
No. 7	10.0	....	0.2	....	....	1.2
No. 8	4.0	....	....	....	....	....
No. 9	4.0	....	0.3	....	....	....
No. 10	4.0	....	1.5	....	2.0	....
No. 11	....	5.0	....	....	....	....
No. 12	....	12.5	....	....	....	....
No. 13	....	....	3.75	....	....	....
No. 14	....	14.0	1.0	....	2.5	....
No. 15	1.25	5.0	0.5	....	....	....
No. 16	....	7.0	0.3	....	....	....
No. 17	....	....	10.0	....	....	....
No. 18	2.0	3.0	....	....	....	....
No. 19	4.0	5.0	....	....	....	....
No. 20	1.5	1.0	....	....	2.25	....
No. 21	4.0	1.75	....	....	4.0	....
No. 22	8.0	1.5	....	....	....	....

[a] Aluminum content = remainder.

Industry's Part in Social Progress

RALPH E. FLANDERS
President, Jones & Lamson Machine Company

AT THIS MOMENT all of the productive and constructive elements of this nation are engaged in a common task and are working toward a common end.

But the task before us and the ends we seek are seen in different aspects by different units of the co-operating groups. Some have taken a narrow sector for their field, others a wider one. For some the ends are obscured in a devotion to the means employed; for others the ends are so vast that they are magnificently vague, and the means are indeterminate.

These things being true, it is no wonder that we have the appearance of a nation working frantically at cross purposes. Some are intent on raising prices, some on lowering prices, others on price fixing. Some would increase working hours, others decrease them. Some would cut governmental expenditures, others expand them. Some would take land out of agricultural production, others—or even the same persons—would initiate irrigation projects which will increase the crop yield. Some call for a closer governmental or industrial control, others plead for more freedom. And all of this is but the first page of the volume of our inconsistencies.

Fronted as we are by this confusion we must in the first place seek some clear statement of our purpose—a statement which will be broad enough to be generally acceptable, yet deep enough to have a content of vital social meaning. It must be an expression of purpose on which industry, agriculture, commerce, finance and statesmanship must perforce agree. Let us attempt such a statement.

As our social objective in the material realm, we would provide for the mass of the population a scale of living which on the whole is continually rising, and is free from severe or destructive fluctuations. In the spiritual realm we would diminish the need for consuming anxiety among the body of the population, and would foster and preserve such elements of personal liberty as are not in conflict with the preceding purposes.

From an address at 50th Anniversary Dinner of Cincinnati Milling Machine Company, Cincinnati, Ohio, Friday, October 12, 1934.

It is highly important that we state our objectives, and that we put them in terms of human values; for human values are the real objectives of a co-operative social undertaking, such as that in which we are engaged. The purpose of our co-operation is not and cannot be the strengthening or defeat of a labor organization or of a political party, the return to the gold standard or the adoption of some kind of a managed currency, the expansion or contraction of the national debt, the increase of government-operated business undertakings or the withdrawal of government therefrom, the regimentation of industry or the encouragement of free competition, the raising, lowering or fixing of prices or the price level. On all of these things and on many more of similar importance each of us holds strong views. But is there any one of us who would not willingly change his views and seek means of corresponding changes in business and financial practice, if it became clear that we could thereby more readily and safely gain our common social ends?

These other matters, important though they be, are only means to an end, not the ends themselves. We can the more easily view them with an open mind, and enter into the necessary adjustments and compromises relating to them, if we recognize them as means, not ends.

Material Objective

Let us consider particularly the first element in our stated purpose, expressed in these words: *"As our social objective in the material realm, we would provide for the mass of the population a scale of living which on the whole is continuously rising, and is free from severe or destructive fluctuations."*

Now the scale of living is determined by the volume and quality of goods and services placed at the disposal of the individual. The provision of these goods and services is the task for which industry is organized—it is the reason for its very existence. We thus arrive directly at the heart of our problem.

Our objective requires that more and better goods and services be provided, and distributed. Higher and even higher production is the direct and primary means to this end. Those of us who are in industry, and particularly those of us who devise and provide the tools of industry, have no doubt in our minds as to the physical possibility of continuing this improvement in the scale of living which has been in progress for the last century and a half. The improved machines and advanced forms of organization are here, and further and yet further progress is in sight. Why should we not move forward?

The responsibility for our delay cannot be placed *in toto* on the shoulders of any one person or group. Government, labor, and industry itself will have to share the blame.

Business, until very recently at least, has been fascinated by programs of production control, price fixing and other practices, aiming toward assurance of profits but ignoring this primary need for more goods and services. In fact these programs work for fewer goods and services and thus for a lower standard of living. Such policies will not even give that assurance of profits which is their purpose. They will only assure ever-shrinking profits on a shrinking volume of business and a lowered scale of living. The reasons for this I will not now discuss, having recently done so on another occasion, when the close parallel between these policies and those of union labor was pointed out. (*AM* —Vol. 78, page 668).

As to the Administration, we have already noted that its policies have been numerous and conflicting. With one hand it has sought to raise prices and with the other to lower them. It has sought to expand business operations and business credit, at the same time that its really effective agents in legislation and administration were seeking materially to diminish business profit and even the hope for profit. For political purposes it has given its preponderating support to one type of employer-employee relation—the labor union—even though conventional union policies tend away from, rather than toward, the objective we all wish to attain.

In seeking to correct the faults of attitude and action which stand in the way of recovery we will run afoul of

false conceptions in all of the groups, and with some fallacies which are common to all; but the major misconceptions appear to lie in the inability to realize that more goods and services, rather than changes in hours and wages, is the essential thing; and in the failure to appreciate the function of profit from productive business as the effective provider of this plenty, and of the increased employment by which this plenty is distributed.

Let me pause at this point to say something of very great importance. It is required by the conditions through which we are passing that industry make plain to itself its relations to the social problem, doing it honestly and realistically. Having done so it is required that it shall speak out clearly, directly and without reserve, not only as to its own functions and duties, but with relation as well to the function of its partners, labor and government. There is no substitute for clear thinking and plain speaking if we are to make progress toward our social goal.

With this preparation, and in this spirit, let us proceed with our discussion.

There is perhaps no better way to approach this aspect of our problem than to study the official view of the American Federation of Labor, presented in the annual report of its Executive Council, and as published in the *New York Times* for Monday, October 1st, 1934. It is too long a document to give in full. An endeavor will be made to give a fair condensation, interspersed with comments.

> "The volume of goods produced and the aggregate of services rendered is our real national income. In these terms our economic history has been the history of swift and gigantic industrial growth. Along with almost constant acceleration in the rate of output went the steady expansion of the consuming power of the American people."

This opening sentence forms an excellent statement of the conditions productive of a rising standard of living.

> "Following the collapse of our top-heavy debt structure in 1929, the real income of the nation began to fall off at a rapid rate.
>
> "Today we have about five million more residents in the continental United States than we had in the predepression year. To provide for these additional millions of Americans on the 1929 scale our production must exceed the volume attained in that year. This can be done only by reconstructing the efficiency and coordination of our entire economic system along new lines. With 10,000,000 wage-earners idle and with a large portion of our factories empty, we must be careful to insure a return to the predepression production levels, which would not be deceptive and temporary but built upon the sound foundation of permanency."

In this statement the labor leaders display an insight superior to those financial leaders who filled the depression years with their warnings that we were suffering from having lived too high—that never again must we produce and distribute as much as we did in 1928 and 1929. Of course this is pure folly. Some individuals may have lived too high for their own good. Some speculative activities were pushed to disastrous limits. But the plain citizens of this country suffered from no surfeit of goods and services.

> "With unprecedented changes in mechanical equipment of industry, the problem of technological unemployment came to the fore since the World War.
>
> "Even accepting the conservative estimate for this period made by Dr. Mills of the National Bureau (Frederick C. Mills, "Economic Tendencies in the United States"), we find that from 1919 to 1929 output per worker employed increased approximately 43 per cent. This means that work requiring one hundred men in 1919 could be done by seventy in 1929, and that thirty out of one hundred could have been dispensed with."

Here the reasoning begins to go wrong. Why need these men be dispensed with? If we want more goods than we are now getting, they can make them for us. If we prefer more leisure to more goods, we can shorten the working day. But note that shortening the working day is not the way to get more goods. There is doubt about the facts, as well. Statisticians apparently do not agree. Data to be introduced later indicate that the industrial production per capita did not rise more than 20 per cent in that period, and that there was no increase in percentage of unemployment to be reckoned with.

> "The years of business prosperity brought not only expanding production and rapidly increasing productivity, but also instability of employment and uncertainty of income to the wage-earner."

The tendency toward increased instability of employment rather than an increase in unemployment, is one of the real evils of increased mechanization, and of the uncontrolled operation of our credit money system. Here is a real field for improvement. It is possible both to decrease the instability and to protect the worker from what remains*—possible, that is, if the profit system is permitted to perform its full social function.

> "According to the recent figures of the National Bureau of Economic Research, between 1929 and 1933 the output of the worker per man-hour was increased by 27 per cent.
>
> "A work week averaging about fifty hours in 1929 has been reduced to about thirty-eight hours in 1933, with the depressed rate of activity keeping the weekly hours well below the maximum prescribed in the NRA codes. This 25 per cent drop in weekly hours reduced the total man-hours by 50 per cent since 1929. Under these circumstances a 27 per cent advance in the output per man-hour is indeed striking."

These figures are rather startling, indicating, as they do, our increase per worker of more than 80 per cent since 1919. It is doubtful whether they constitute a fair section of industry, or are taken from exceptional samples. One thing is sure—for business as a whole this latest increase in efficiency was developed out of the necessity for keeping out of the sheriff's hands. It was the price of survival, not the source of profits.

> "During the post-war decade, the volume of goods and services produced in the United States was being increased at a rate never before maintained for a similar period of time. But under this rapid acceleration in the rate of production, the economic system was showing definite strains and maladjustments.
>
> "We have every indication that too large a proportion of our productive resources was poured into the production of durable goods and especially of capital equipment. It is highly significant that the falling off in the production of durable goods and capital equipment was the most important factor in the decline of the productive rate during the depression."

Here the document, like nearly every other one of its kind, leaps to the purely gratuitous assumption that the "strains and maladjustments" and any unwise additions to capital goods were derived from undue profits and from a serious maldistribution of wealth *in industry*. These phenomena did not appear *in industry*. The dogs have been barking up this tree for years; but they can't get the coon. *He isn't up that tree.*

The strains and the maldistribution and the unwise provision of capital goods were derived from the billions of dollars of fallacious purchasing power injected into our economic system by credit based on speculation, and disastrously destroyed by the four years of inevitable and retributory deflation. The coon is up *that* tree, miles away from where the dogs are barking.

> "It is important to realize that in the post-depression period the purchasing power of the consumer will be applied primarily to the acquisition of commodities most essential for human consumption. It will be some time, therefore, before we begin to increase savings—some time, in other words, before we begin to spend on a large scale for future incomes and thus supply investment funds necessary for new production of capital equipment.
>
> We are thus faced with potential serious checks to reabsorption by the industry of those now unemployed."

*See author's paper "An End to Unemployment" published by the Industrial Advisory Board of the N.R.A.

This is a fair statement of the inexcusable condition into which current trades union and governmental policies have been leading us. It *is* going to be some time before we increase savings and supply investment funds for capital equipment; therefore, it is going to be some time before the main body of the unemployed, normally producing capital goods, are taken off the relief rolls and permitted to earn the good living which they are capable of earning. And this is because we have been willing to encourage anything except business profit, which is the only thing which can employ the unemployed in the depressed industries. Instead of fresh air, pure water, nourishing food and exercise, we are treating business to dope, bloodletting and hypnotism—and some of this teratment is self-inflicted.

> "Further and substantial increases in wages for industrial labor must be made to encourage a demand for durable goods, as well as consumption goods.
>
> "Provided with adequate purchasing power, we can substantially accelerate the rate of production of goods and services."

And so we can. But why is purchasing power so shy? We raise wages, we "prime the pump," we cram the banks with credit. All is of no avail. Before the phantom of false morning died we thought a voice within the temple cried "When all this credit is prepared within, why lags the doubtful business man outside?"

The answer is simple. We are deficient in purchasing power. We are deficient in that principal element of purchasing power *and employing power* which is represented by credit money, and is generated by bank borrowing for current business operations. That borrowing cannot and should not take place on an increasing scale until the prospect of business profit becomes hopeful. And this will be difficult until labor, while correcting local and specific injustices, develops for its major strategy something more constructive than mass attacks on slender and vanishing profits.

When labor permits, when government encourages and when shrewd business takes a chance, then will re-employment and rising real wages proceed with accelerated pace.

> "There is ample evidence of the immediate and pressing need for a further shortening of hours of work as a first step towards stabilization of employment. The general adoption of a shorter work week is bound to bring a sustained industrial stability."

What a strange conclusion, presented *without* the evidence, and in the face of the introductory statement that a rising standard of living demands more goods and services! And what a direct blow at re-employment in the depressed industries, whose only hope lies in the re-appearance of profits, which this policy would destroy!

> "Labor should be given an opportunity to join hands with the management in the great national enterprise of rebuilding our industrial economy on the basis of social as well as economic efficiency and thus assure a return to prosperity more permanent and more equitable than we have seen."

To this let us say a hearty Amen! This past year I have had the pleasure and honor of meeting a number of the principal labor leaders of the country. It is impossible to make their acquaintance and not be impressed with their intelligence, honesty and devotion to a worthy cause. If they can forsake their concentration on attractive but shallow and ineffective means, and will join in a search for effective and practical ways of attaining such ends as were set forth at the beginning of this document, they may demand that business take the no less difficult step of meeting them halfway.

Statesmanship in Labor, joined to statesmanship in Business, will generate statesmanship in Government—and thus three vacuums will be filled.

There is no need to go into an analysis of the underlying fallacies of this A.F. of L. document, or of the corresponding underlying trend of governmental attitude and policy, which so faithfully follows it. That task was done effectively two weeks before the A.F. of L. meeting by Col. Ayres in the Cleveland Trust Company Bulletin of September 15—one of the most remarkable documents that has come to light in many months.

Destroying the Fallacies

Col. Ayres challenges and destroys the seven major economic fallacies; overproduction, concentration of wealth, effectiveness of redistribution of income, high profit margins, taxation possibilities, effectiveness of inflation, and recovery through consumer purchasing power.

What, then, shall we do? We have been discouraged and thwarted by the policies which have been proposed, accepted and acted upon by government, by labor and by some sections of industry itself. These policies, based upon fallacies, have hitherto prevented the attainment of the reasonable hopes of our people as a whole.

So has it been up until this moment. But there are clear evidences of a change in the wind.

As to labor, the short-sightedness of its leadership is becoming evident to all. The mass of workers will not long remain content with the only fruit which traditional union policy offers—apples of Sodom, fair to the eye, but devoid of nourishment, and with no taste on the tongue but that of the bitter ashes with which they are filled.

Industry is learning its lesson. There were apples of Sodom even in the N.R.A. fruit basket. They do not satisfy, and more realistic policies are being sought.

As to government, the outlook is better than it has been at any time in the recent past. Faith in fallacies is waning. While the hope of recovery by combined bleeding and forcible feeding still persists, the Administration—including the President himself—appears to be in a more receptive mood for permitting industry to tackle the job in its own natural way. Have we enough strength and courage left to meet and match our opportunity?

The effective way is the old way. We have just passed through a minor cycle of temporary depression in what may be, and must be made, the major curve of recovery. The worst is now behind us. Here and there, in slowly increasing quantities, will be found industrial companies and groups whose current operations are satisfactory, and who would be willing, under ordinary circumstances, to venture into a little larger scale of operations. Let these firms do so. Let them run the risk—smaller now than in any recent time—of an assault on their constructive efforts by government or by labor. Let them, and industry in general, continuously educate themselves, government and labor to the end that such assaults may be warded off.

Such moderate, judicious, but widespread expansion of business enterprise is the stuff of which a safe recovery, a solid prosperity, is made. Nothing can take its place—not "priming the pump," or forced injections of credit into specific enterprises, however worthy. The safe expansion of credit, of employment and of purchasing power comes from a natural, unforced expansion of this type, made in the hope of expanded profits.

And these profits from the normal operations of production and distribution of goods and services, even though they rise to high percentages in many individual instances, will not lead to mal-distribution of wealth or to serious fluctuations in business. Profits of this sort flow steadily into the markets for durable and capital goods and into the expansion of personal and social services. On the expansion of these profits depend our only solid hopes for large scale re-employment. We have no other hopes. We know of no other way.

On these profits, finally, depend the initiation and maintenance of those social services by which we hope to safeguard the worker from anxiety and want. There is no other source of support. Without profits to draw upon, these are paper plans—unsubstantial visions of the night.

• IDEAS •
FROM PRACTICAL MEN

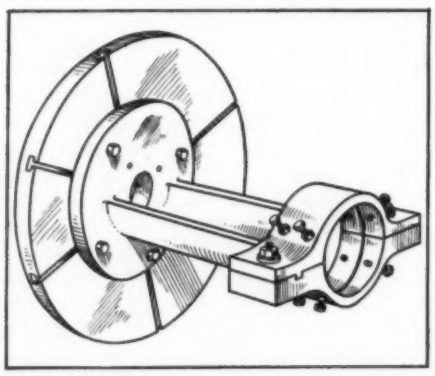
Fixture for Reboring Motor Bearings

W. S. GALLMAN

For reboring relined motor bearings, the fixture illustrated was made before my time, but was not a success. It was mounted on the faceplate of a lathe, and each time it was set up, it was found that it did not run quite true.

We bored the hole in the fixture slightly larger, drilled and tapped eight holes and put in screws, holding them in adjustment with locknuts. The inner ends of the screws were then machined by a boring tool to fit the outsides of the bearings, the bearings being clamped by the cap of the fixture. The illustration shows the scheme.

When bearings are to be bored, we run in the screws a quarter turn and machine the inner ends to fit the bearing, so that it will run true when clamped in the fixture. By using split rings for spacers we are able to use the fixture for boring several smaller sizes of bearings. The use of a fixture of this type insures that the bearings will be held true and saves time over the usual method of holding them in a 4-jaw chuck.



Each time the fixture is set up, the screws are turned in slightly and their inner ends are machined to fit the bearing so that it will run true

Grooving Rod Bushings

HERBERT F. CRAWFORD

Methods used to get the oil distributed to the bearing surfaces vary widely. Arguments as to the advantages of oil grooves are still rife. One railway shop, however, still believes in grooving, as seen in Fig. 1, which shows the tool inside the bushing and the crossed oil grooves that have been cut.

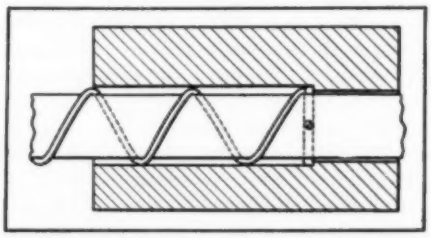
The grooving machine was built from an old engine lathe, the plan of securing the reciprocating motion being shown in Fig. 2. A gear on the end of the spindle drives a gear train that includes a pair of bevels, which rotate the slotted disk in front of the guard over the large back gear. The connecting rod moves the carriage and the grooving tool back and forth, the motion depending on the position of the pin in the slot. The connecting rod is bent to clear the gear guard on the up stroke. The back end of the rod has four holes for changing the relative position of the tool carriage and bushing.

Device for Removing Chips in Horizontal Boring

J. E. MOORE

In boring some 2⅜-in. holes 8 in. deep in cast iron, we had trouble from the chips gathering in the lower side of the holes and wedging under the boring bar, causing heat and rough work.

We then built a helix of solder around the boring bar, making a sort of shallow conveyor, as shown in the illustration. As the bar revolved, the chips were drawn out of the holes and we had no further trouble with the job.



A helix of solder built around the boring bar, making a shallow conveyor, drew the chips out of the holes as the bar revolved

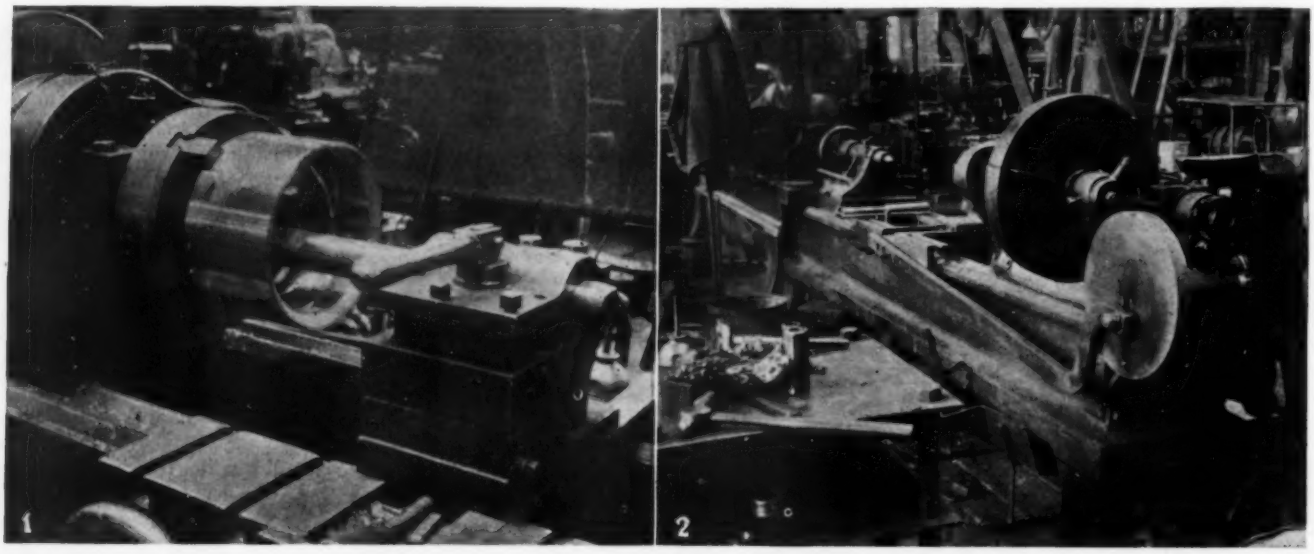


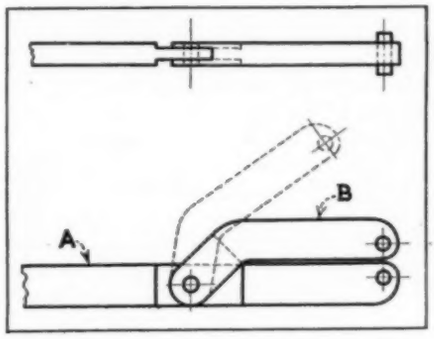
Fig. 1—A reciprocating motion for the carriage is used to cut oil grooves in rod bushings. Fig. 2—Length of stroke is varied by shifting the pin in the slotted disk

A Universal Pin Wrench

H. C. SEEGERS

In the illustration is shown a universal wrench of the pin type for turning round nuts having pin holes in the sides. To the lever *A* is pivoted the link *B*, both parts being provided with pins to fit holes in the nuts. As link *B* can be swung about its pivot as a center, as indicated by the dotted lines, the wrench can be adjusted through a wide range to fit nuts having pin holes in circles of various diameters.

Adoption of this wrench has simplified the manufacture of round nuts to be turned by a pin wrench, since accurate spacing of the holes is now of minor importance.



Round nuts having pin holes in their sides, and varying considerably in diameter, can be turned by this universal pin wrench

Torch-Cut Bulldozer Dies

FRANK C. HUDSON

Good torch cutting has reached the stage in one railroad shop where dies for bulldozer work need no further work in the way of finishing by machine. Several such dies are shown on the shop truck in Fig. 1. They are for various simple parts used in car work such as a brake lever carrier and draft gear carrier iron. They are cut with a pantograph machine and are both satisfactory and economical.

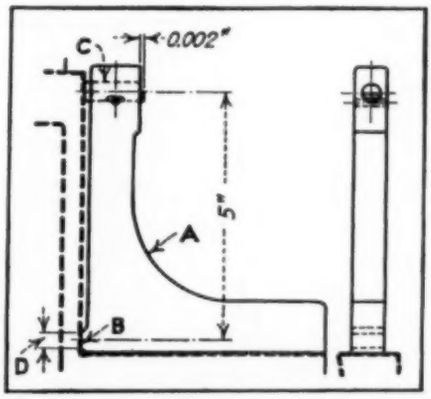
The die in Fig. 2 is for a special bracket. The two parts shown make the first bend; other similar dies complete the part. Expert flame or torch cutters can do much to reduce costs on work such as this.

A Flush-Pin Try Square

J. E. FENNO

We had an order to build some centrifugal pumps. According to the specifications the two surfaces of the casings indicated by sectional lines in the illustration must be square with each other within plus or minus 0.001 in. in a distance of 5 in. Employing an ordinary try square to check the squareness of the surfaces would necessitate the use of feelers to determine the amount of error, if any, and would require considerable time to check each piece.

To speed up the checking, we made the flush-pin square illustrated. It consists of the body *A* having a lug at *B*, and the sliding flush pin *C* having a step of 0.002 in. on its inner end. It is important that the diameter of the flush pin and the dimension *D* of the lug *C* be the same, and that the distance between the center of the lug and the center of the flush pin correspond to the specification, which in this case is 5 inches.



The squareness of the work within the allowable limit can be easily and quickly determined by rubbing the finger over the step-end of the flush pin

In checking the surfaces for squareness, the square is placed in the position shown and the flush pin is pushed against the vertical surface of the work. Then by rubbing the finger over the step-end of the flush pin, it can be easily and quickly determined whether or not the squareness is within the limit allowed by the specification.

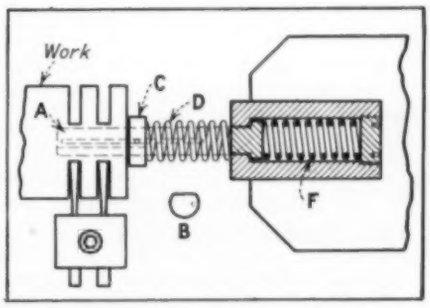
Stripper for the Product of a Turret Lathe

CHARLES KUGLER

Where multiple cut-off tools are used in the turret lathe there must be some means to prevent the severed pieces from being wedged between the tools.

In the device illustrated, the pilot *A* is a loose fit in the hole in the work and is slabbed off on one side to clear the cutting edges of the tools, as shown in the end view *B*. It also has a keyseat that is engaged by a pin in the collar *C* to prevent the collar from being pushed off by spring *D* when the pilot is clear of the work. When the turret moves forward, the pilot enters a hole previously drilled in the work and collar *C* comes into contact with the end of the stock, compressing spring *D*. After the work has been cut off and the turret moves back, the cut-off tools recede from the work and the severed parts are left on the pilot.

Spring *D* then pushes collar *C* forward,



A simple device for stripping the work from the pilot and preventing it from causing damage by being jammed in the cut-off tools

stripping the work from the pilot. Should the drill break before finishing the hole in the work, or should the pilot meet with any obstruction in entering the hole, spring *F*, which is held in the hollow shank of the device and is stiffer than spring *D*, will be compressed and permit the pilot to recede within the hollow shank and so prevent damage.

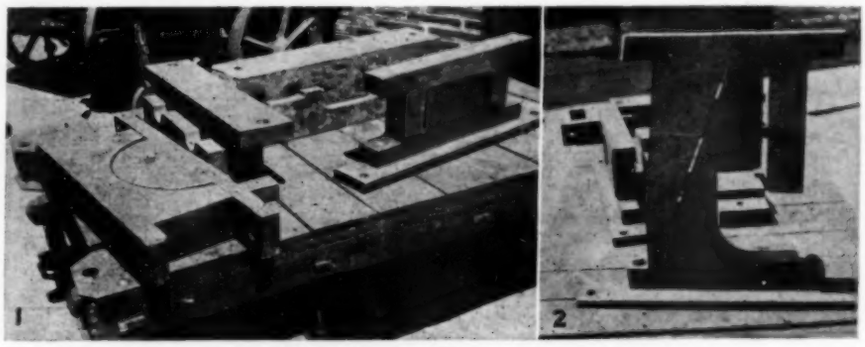


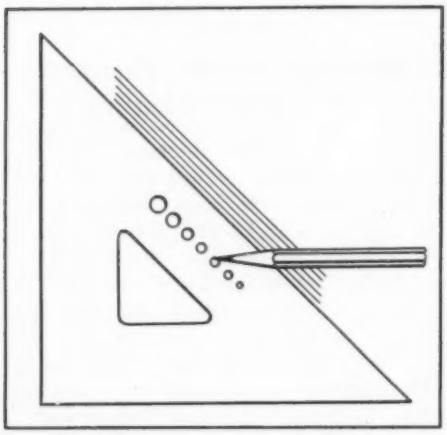
Fig. 1—These torch-cut bulldozer dies need no machining. Fig. 2—Bending dies for a special bracket

A Simple Section Liner

S. O. DODGE

In the illustration is shown a 45-deg. triangle that has been converted into an efficient section liner by simple means, giving the draftsman another tool without cost or the care of an additional instrument.

A row of holes varying from $\frac{1}{16}$ to $\frac{1}{4}$ in. in diameter is drilled parallel with the 45-deg. edge of the triangle. After one section line has been drawn, the pencil point is inserted into one of the holes and against one edge. The triangle is then moved along the T-square until the opposite edge of the hole touches the pencil point, making the spacing for the next line, which can then be drawn. This process is repeated until all the lines have been drawn. Different spacings can be had by using holes of different diameters.



After each line has been drawn, the pencil point is placed against the edge of one of the holes. The triangle is then moved until the opposite edge of the hole touches the pencil point

Magnetic Chuck for Grinding Taper Gibs

C. W. PUTMAN

Shown in the illustration is a magnetic chuck for holding taper gibs while grinding the flat surfaces. The gibs are 18 in. long, having a taper of $\frac{1}{4}$ in. per ft. and are placed at a sidewise angle of 30 deg. in the chuck.

The body *A* of the chuck is cast brass and has fourteen inserts *B* of cold-rolled steel properly connected in magnetic circuit. Each insert has two holes drilled for anchorage and extends $\frac{1}{2}$ in. beyond the sides of the chuck to enter pockets in the mold made by core prints. The projecting ends are afterward machined flush with the sides of the casting. Stop plate *C* is attached to one end of the chuck and carries the stop pin *D*. The adjustable screw *F* has a diamond in its point for truing the abrasive wheel and is held in position by a checknut.

Since the taper of the gibs is $\frac{1}{4}$ in. per ft., placing them in the chuck at an angle of 30 deg., sidewise changes the taper presented to the tool. The tangent of the angle to plane the seat in the chuck is found by the following formula:

$$\tan = \frac{0.25 \times \cos 30 \text{ deg.}}{12} = 0.01804$$

and the corresponding angle is 1 deg., 2 min., or a taper close to $\frac{7}{32}$ in. per foot.

Setting Tools Accurately Discussion

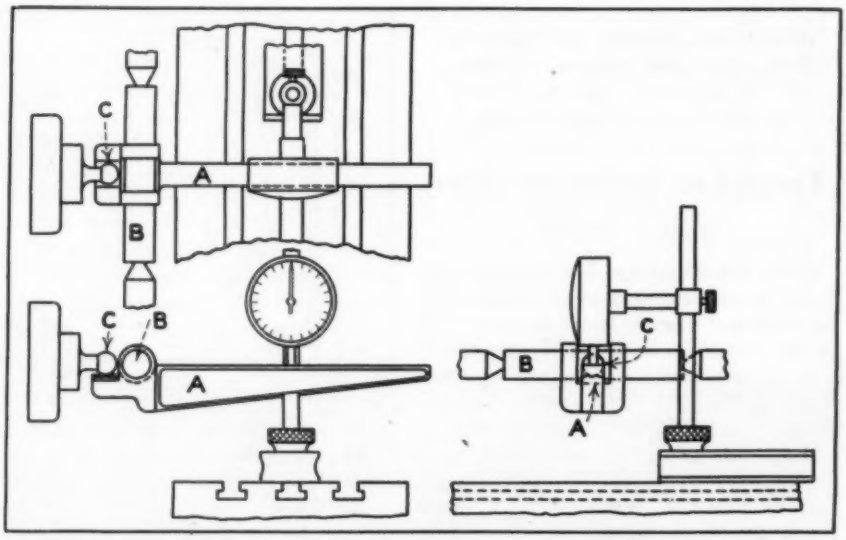
MATTHEW HARRIS

Referring to the article under the title given above by Peter L. Budwitz (*AM*—Vol. 77, page 752), what Mr. Budwitz is really aiming at is to set the index centers of his milling machine accurately in the same plane as that of the center of the spindle.

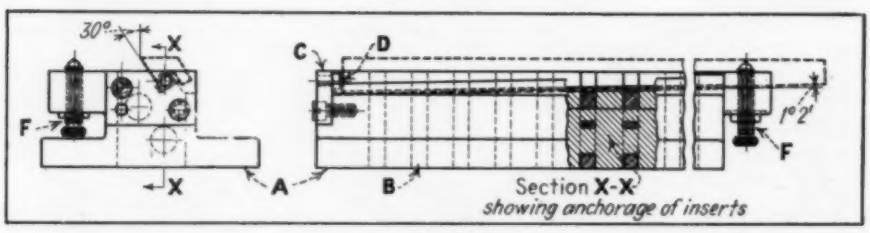
Nearly all universal milling machines have a line scribed on one edge of the vertical slide for the knee to tell when the knee is at the right height for the index centers to be at the center height of the spindle. Some machines are provided with scales and verniers, the verniers reading zero when the index centers are at the center height of the spindle. Lacking the scale and the vernier, if the line on the vertical slide is not accurate enough for his purpose, then Mr. Budwitz can get the desired result with the device illustrated.

The device consists of the lever *A*, the short mandrel *B*, and the ball center *C*. It is used in conection with a surface gage equipped with a dial indicator. The upper surface of the long arm of the lever is accurately in line with the centers of the holes for the mandrel, and the upper surface of the short arm is below the upper surface of the long arm an amount equal to the radius of the ball center. Both upper surfaces of the lever are parallel.

With the lever mounted on the mandrel and the mandrel held between the index centers, and the ball center in the spindle, raising the knee will depress the short arm of the lever and raise the long arm. Lowering the knee has the oppo-



With the ball center in the spindle and the device mounted as shown, the index centers can be accurately located at the center height of the spindle



Setting taper gibs at a sidewise angle modifies the taper to which the seat in the chuck must be planed. The correct taper is found by the formula given in the text

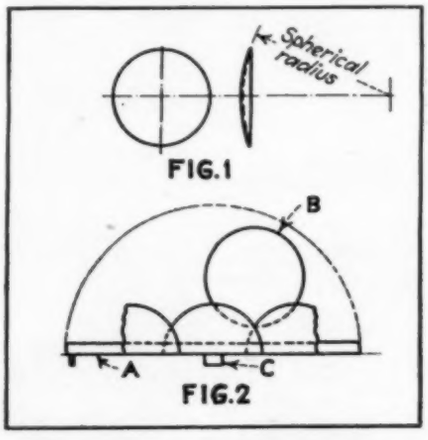
site effect. When the knee is adjusted so that the indicator can be moved along the whole length of the upper surface of the long arm of the lever without changing the reading, then the index centers are in accurate alignment with the center of the spindle.

Making Hollow Spheres

C. F. STAPLES

An order was received by a jobbing shop for several hollow spheres 6 ft. in diameter, to be in halves and doweled together. No material was specified, but they were to be made as cheaply as possible and were to be coated on the outside with waterproof cement. The main consideration was to have them light in weight, but not necessarily waterproof before the cement coating was applied.

The spheres were made by riveting together a number of sheet-steel disks spun to a radius of 3 ft., one of the disks being shown in Fig. 1. The wood form



The spheres were built up from steel disks spun to a radius of 3 ft., the first row being cut in half and riveted to a steel ring

over which the disks were spun was turned to radius enough less than 3 ft. to allow for the spring-back of the metal.

A number of disks were cut in half and riveted around the 6-ft. steel ring *A*, Fig. 2. Then full disks, as at *B*, were lapped under the half disks and riveted to each other and to the half disks. The lapping and riveting process was continued until a half sphere had been formed, the other half being made in the same way.

Four flat strips *C* were riveted to the inside of ring *A* for locating the two halves of the sphere. In building the spheres, each disk was clamped in place and the rivet holes were drilled with an electric drill.

SEEN AND HEARD

JOHN R. GODFREY

650 Old Timers in Milwaukee

Except in mass production, where highly specialized machines perform operations accurately and men or women feed them and remove the finished product, craftsmanship is still a real asset. But while comparatively few industries come in the mass production class they account for large numbers of employees. Shops which depend on craftsmanship rely on the experience of men trained in their line of work and such shops appreciate their value more than others. As a result they use every effort to retain trained men by providing good working conditions and considerate treatment. The Old Timers' Club of the Harnischfeger Corporation of Milwaukee, Wis., is a good example. It contains 324 men with a 5-year record, 172 with 10 years, 84 with 15 years, 23 with 20 years, 19 with 25 years, 19 with 30 years, 8 with 35 years and 1 who has been with the company 40 years. Just what this means in dollars cannot be determined. But the effect on the stability of the community can hardly be overestimated.

Welded Jigs and Fixtures

Some things come into use very slowly. Welded jigs and fixtures are a good example. The first of these I ever saw was in a small bicycle shop outside of Birmingham, England in the early spring of 1914. They were used quite extensively in this shop. It was a number of years before I saw the next ones. And only last week the fixture engineer (if that is his correct title) of a large tool shop told me of the struggle he was having to introduce welded fixtures into his own shop. He is sold on the idea and has figures to prove the economy of his belief, not only in dollars but in time of delivery to customers. Clinging to old ideas is not confined to religion, politics or economics. We shop men have our own prejudices that delay progress.

Trying New Things

Constantly trying new steels, new cutting lubricants, new makes of tools may indicate either progress or the reverse, according to conditions. Each steel presumably gives best results when it is forged and heat-treated in a certain way. The more kinds of steels you have in the shop the greater the chance of error in using some of them. Yet it is surely a sign of utter conservatism to adhere to the "good enough for me" attitude.

Plants with research departments should be constantly trying new steels and other materials. In this way they keep abreast of the times. But most small shops may make more real progress by making changes more slowly, sticking to what they know is good until they find something they are very sure is better. As in all walks of life, it's a case of using as good judgment as possible.

Measuring Angles, Flats and Diameters

Many of us think of optics as being new in the shop field. Yet we have all used the principles of "light" gages many times. True, it was simple holding mating surfaces toward the light to see how well the surfaces fitted. This has been used in testing squares, contours and drill points as well as thread forms. We also used accurate levels in many cases. Now we have optical protractors which are mighty handy in drilling holes at accurate angles, and for many places where we were brought up to use the sine bar or the button method. Indexing has also been given optical assistance and the optical flat reveals unbelievably small variations from absolute flatness—they talk in millionths of an inch when they use these flats. They can also be used to select balls or rollers of uniform diameter and for a variety of other uses. Fortunately, they do not cost as much as one might expect, either. Even if you don't use these modern tools, it's a wise plan to get posted about them.

Cadmium Plating

The thickness, or thinness, of electroplated coatings is quite important from several viewpoints. The amount of metal required counts up in costs even when the thickness is measured in tenths instead of thousandths. The time required for plating is another item. And the effect of the coating on mating parts, either plain or threaded, must be reckoned with. These reasons give cadmium the advantage in many places. Government specifications call for only a 0.0003 in. coating of cadmium as compared with 0.001 in. for zinc, and users find that even 0.0002 in. is sufficient in most work. The cost is given as approximately 1 cent per sq.ft. Then too, the light coating required will not materially affect fits with the tolerances used on the majority of work. It's another case where the shopman must keep posted on the newer materials.

SHOP EQUIPMENT NEWS

Ajax Air-Clutch Forging Machines

The Ajax Manufacturing Company, Cleveland, Ohio, has announced the completion of a line of air-clutch forging machines, consisting of seven standard sizes rated from 2 to 7 in. inclusive. The objective has been a rapid operating machine of greater rigidity and improved alignment, to increase output and to better the quality and uniformity of the forgings produced.

Increased productive capacity is due to the improved operating convenience of the machines generally, and principally to the employment as standard equipment on all sizes of an air clutch, which was described (*AM*—Vol. 77, p. 736). This clutch is housed within the machine flywheel, and consists of a series of large disks alternately of alloy cast iron and of friction-material-faced steel, which are forced into contact by the direct action of an annular piston behind which compressed air is introduced. The pick-up, although instantaneous, is without shock or impact, which has resulted in the reduction, or practically total absence, of maintenance.

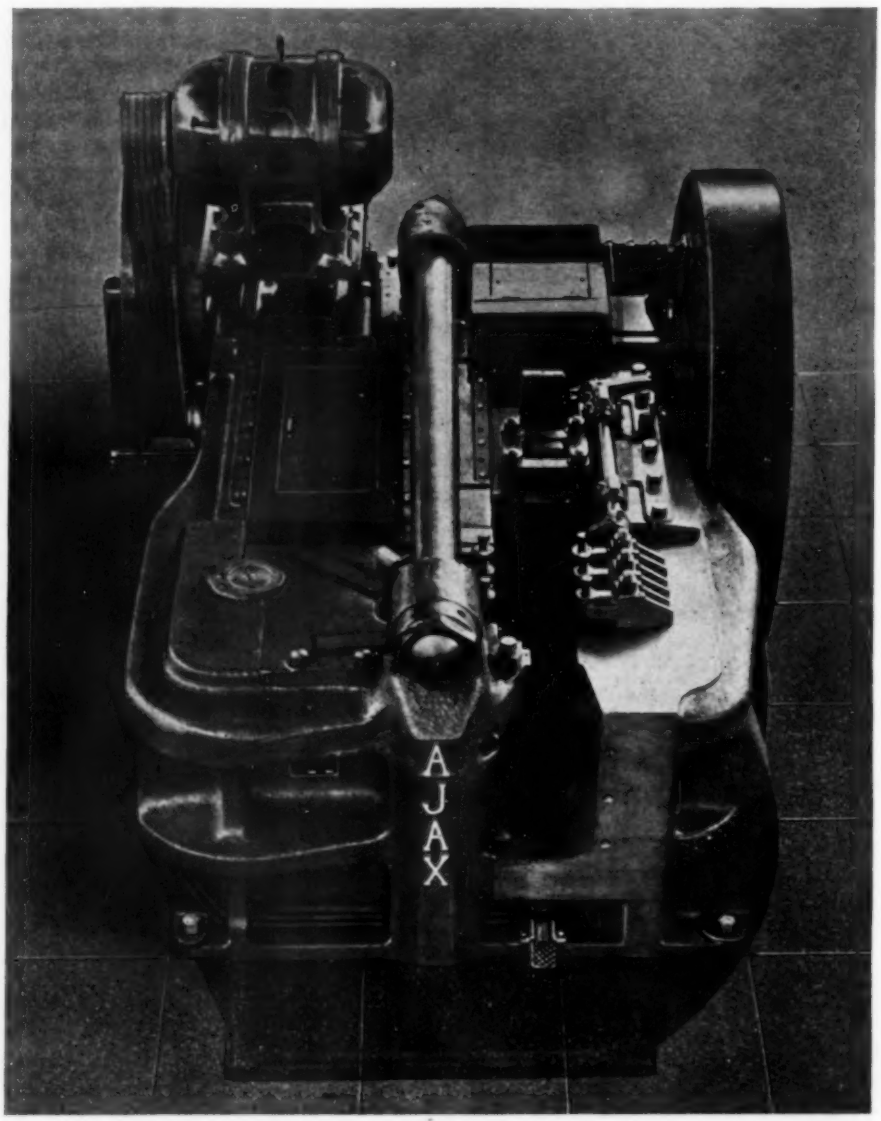
Engagement of the clutch calls for the opening of an air valve from conveniently located pedal. At a predetermined point in the operating cycle the air is exhausted, releasing the clutch, and an air-released, spring-set brake stops the machine on open stroke.

This clutch also makes it possible to "inch" machines of all sizes for die setting, saving time and exertion, particularly where it would be necessary to bar heavy machines over manually. It also serves as an accurately adjustable overload safety device through control of torque capacity by adjusting the air pressure.

The frames of these machines are steel castings. All sizes have heavy sub-floor reinforcement and a large diameter, lengthwise tie-rod spanning the die-slide way. It has been found possible to incorporate in these machines with three main crankshaft bearings, the continuous housings and solid sleeve bearings used in the earlier Ajax machines. The pinionshaft is carried in capped bearings to the rear of the crankshaft, where the clutch and brake are accessible and disassembly is convenient. An innovation on the 6 in. and larger sizes is the introduction of two-stage gearing, which permits employment of a main gear and flywheel of moderate size, economizing floor space.

By locating the outboard bearing of the header slide beneath the crankshaft

Air clutch housed within flywheel

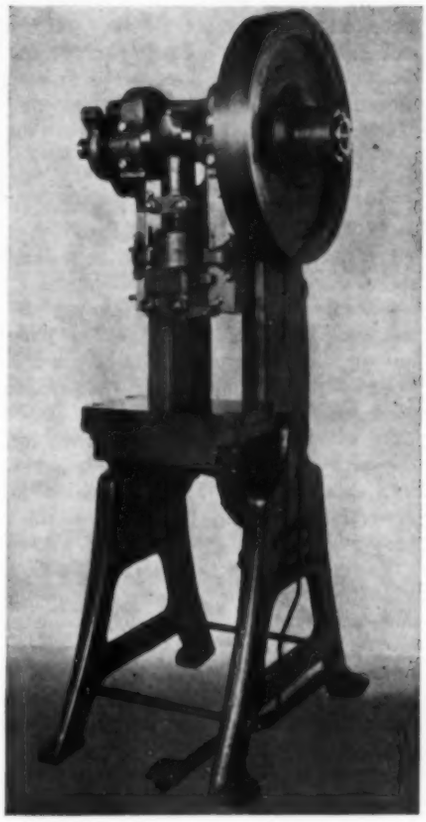


Top view of 5-in. Air-Clutch AJAX Forging Machine showing complete guards

at the extreme rear of the frame, complete accessibility to the pitman and particularly its main eccentric pin bearing is afforded. The outboard guide of the die slide is located beneath and to the right of the stationary die seat avoiding a goose-neck effect with its attendant flexibility, and is kept free from water and scale accumulation through the use of protecting shrouds. A take-up is provided on the guide bearings of both slides to offset the wear caused by the highly abrasive steel scale.

Actuation of the die slide is from cams on the crankshaft. The cam slide bridges the crankshaft and cams, affording convenient assembly and disassembly, and houses the return roller support spring and entire die-slide safety mechanism. This safety is of the by-pass toggle type, fully automatic and adjustable. The springs are mounted so as to remove danger from broken spring rods or stripped spring adjusting nuts, and adjustment of the main safety spring is definitely limited so that it cannot be set beyond a safe overload.

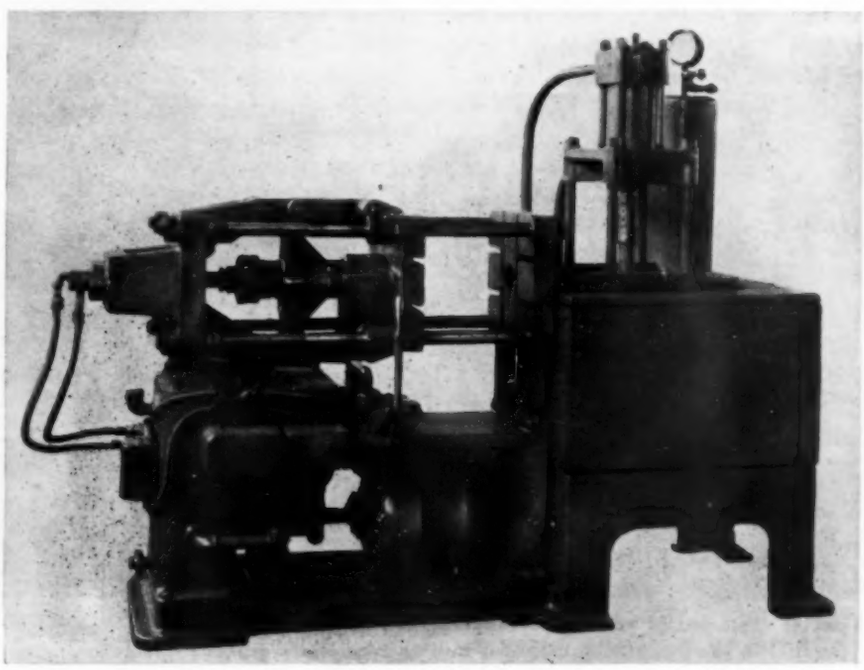
Individual motor drive is provided as standard equipment. Drive to the flywheel is through multiple V-belts.



Lester Hydraulic, High-Speed Die-Casting Machine

A fully hydraulic and self-contained die-casting machine, known as the No. H-HP-1, has been announced by the Lester Engineering Co., 278 Rockefeller Bldg., Cleveland, Ohio. Pressure for injection of the metal into the die is created by the built-in hydraulic pump, and the quality of the finished product is said to be improved. High speed is obtained by means of a fast-moving hydraulic toggle mechanism for die movement. This device develops a locking pressure of 35 tons, which can be utilized in pulling large cores. An automatic plunger control eliminates lost time between the various phases of the cycle. Wear between the plunger and metal cylinder is taken up automatically so that the metal pressure is always maintained.

Operation of the No. H-HP-1 machine is controlled by a single lever. Pulling the lever out will close the die hydraulically. As soon as the die is completely closed and locked the plunger operates to force metal into the die. The plunger holds the pressure on the metal for as long as required for the particular part being cast. An adjustment makes it possible to vary this time delay accurately. The plunger then returns to its original position by pushing the operating lever back and the dies are opened. Specifications are as follows: Die opening 5 in.; maximum die height, 12 in.; minimum die height, 4 in.; clearance between bars, 12x10 in.; metal pot capacity (zinc) 300 lb.; locking pressure on die, 35 tons; plunger capacity, (zinc) 5 lb.; maximum speed, 600 operations per hour; machine weight, 3900 lb.



Federal Improved Flywheel-Type and Back-Geared Presses

The Federal Press Co., Elkhart, Ind., is now building an improved line of presses equipped as standard with Timken roller bearings in the flywheel of all flywheel-type presses and similar bearings in the back-shaft bearings of all back-geared presses. The roller bearing flywheel does not injure the crankshaft as is caused ordinarily by the heavy wheel running on the top side of the crankshaft during the rest periods of the press. Furthermore, the bearing will last for practically the life of the press, thus eliminating much clutch trouble which arises from a loose,wobbly flywheel. Replacement cost is reduced because the Timken bearing is easily replaced if necessary. Turning down the shaft at the flywheel bearing is not required. Therefore, the Timken equipped press is of interest not only from the standpoint of service but also from that of safety, since faulty clutch action causes accidents.

Other improvements in the line are: An improved clamping device in the pitman for holding the adjustment of the ram adjusting screw, an improved upper knockout bracket for simplifying adjustment, and also an improved method of locking the ball cap in place, that eliminates the possibility of throwing the

cap off center. The nut or cap is of the threaded type that screws down on the ball end of the ram adjusting screw, and the locking device is constructed to keep the nut central. Thus, when it becomes necessary to adjust the nut for wear the nut is not out of round.

Kearney & Trecker Cam-Milling Attachment

The Kearney & Trecker Corp., Milwaukee, Wis., has developed a cam-milling slide for use with the Model K universal milling machines. The unit, in combination with the dividing head and tailstock furnished with the machine, converts the standard milling machine into a cam miller. The unit consists of a special slide and base, and a roller bracket.

Power drive for the head is obtained from the spiral change gear unit on the end of the table. The slide movement is provided by pressure of the roller following the contour of the master cam. A weight attached to the slide holds the roller firmly against the face of the master cam.

The slide is arranged so the dividing head spindle may be set parallel with, or at right angles to, the machine spindle. The dividing head spindle is set at right angles to the machine spindle for milling barrel cams, Fig. 1, and parallel for milling face and peripheral cams, Fig. 2. A right-angle drive bracket is used to carry the drive from the spiral change gear unit to the head when it is set parallel to the machine spindle.

One of the features of the attachment is that in many cases one finished cam can be used as the master cam for cutting duplicates. If ten cams of a certain kind are all that will ever be used, the cost of making a master cam can be saved by using the first cam as a master and cutting nine more. No longer is it necessary to make a special cam to be used as a master. However, if duplicate cams are to be cut from time to time, it is advisable to make a master cam.

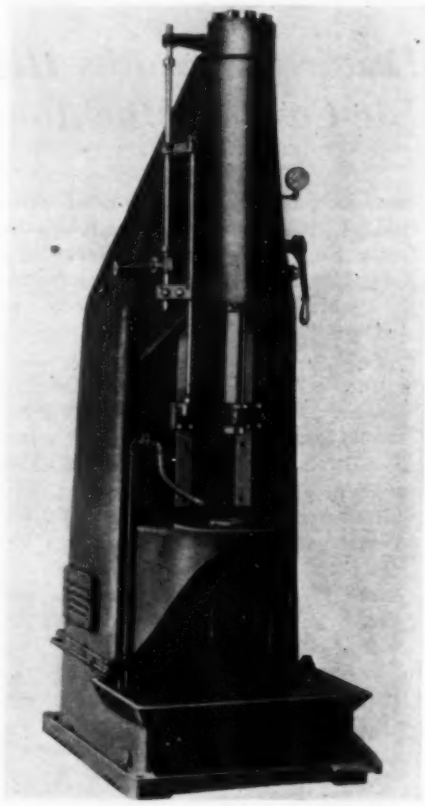
The setup for milling duplicate cams with this attachment is as follows: The attachment is placed on the milling machine table, the dividing head is placed on the slide and the shaft connected to the spiral drive unit for power drive. The master cam and blank are mounted on an arbor which is placed in the dividing head spindle. A roller suitable for the job is placed in the bracket and the proper cutter in the spindle. The slide is then adjusted so the roller is parallel to, and in the same plane with, the cutter. The feed and speed are selected when the job is ready to run.

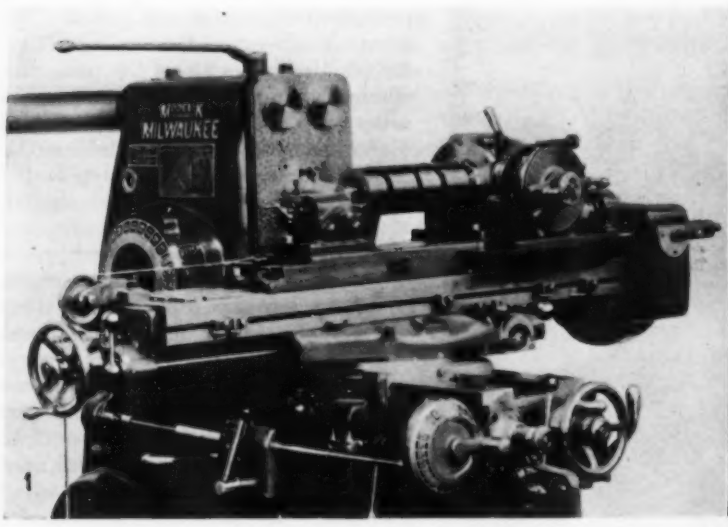
The slide, when used on a No. 2 machine, will accommodate cams up to 10 in. in diameter and 5 in. of travel. Maximum distance between centers is 12 in. The attachment weighs 325 lb.

LaPointe Hydraulic Presses

Hydraulic presses in 6-, 12- and 18-ton sizes are being manufactured by the La-Point Machine Tool Co., Hudson, Mass. Other sizes can be made to customer's specifications. These presses are practically all steel, electrically welded, except for the main pressure cylinder. The ram is guided on hardened and ground steel ways and the sliding member is fitted with replaceable bronze liners. An hydraulic pump is used for operating the main ram and a gear pump for furnishing lubrication. A pedal and hand lever are provided for the operator. The first is used in production and is of a non-repeat type. The hand lever may be used to get the same cycle as with the pedal, or may be disengaged entirely. Ram speed is controlled by the lever on the right-hand side of the machine. Minimum stroke is 2½ in. Controls for continuous automatic cycling can be furnished.

For the three standard models, the stroke is 24 in., the open height is 30 in. and the shut height is 6 in., and the size of the platen is 18 x 36 in. Throat depth is 9 in., maximum speed down is 24 ft. per min., and maximum speed up is 54 ft. per min.





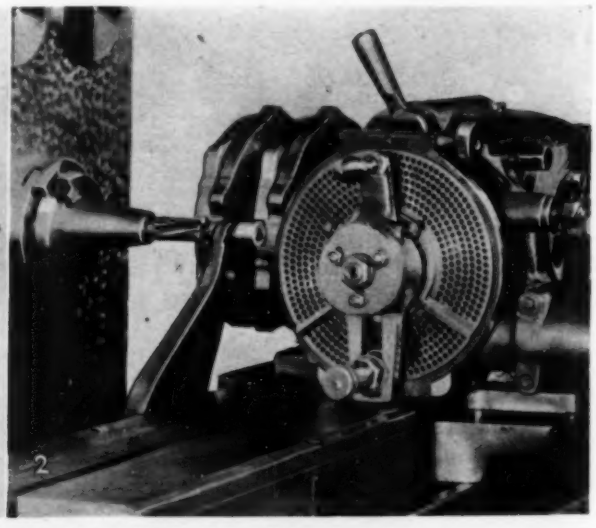
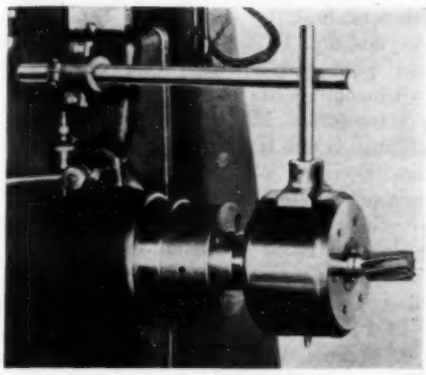
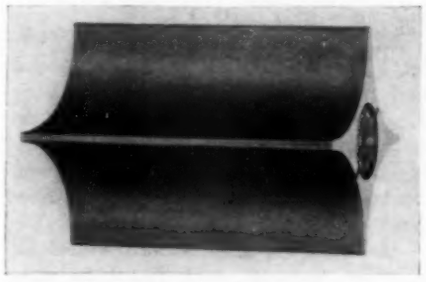


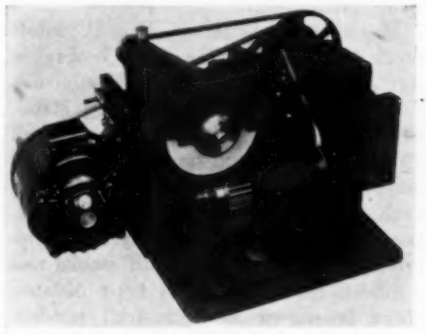
Fig. 1—Dividing-head spindle set at right angles to the machine spindle for milling barrel cams
Fig. 2—Dividing-head spindle parallel to the machine spindle for milling face and peripheral cams



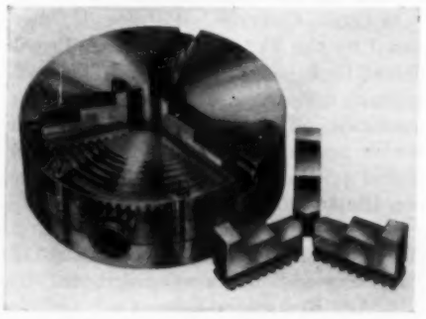
Ex-Cello-O High-Speed Milling Head increases machine speeds



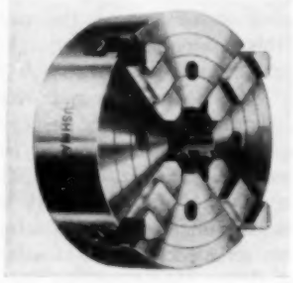
Brown & Sharpe Surface Plate Square



Wardwell No. 35T Saw Grinder



Cushman Self-Centering Chuck



Cushman 4-Jaw Chuck

Ex-Cell-O High-Speed Milling Head

The Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich., has announced a high-speed milling head that is adapted for use on horizontal boring mills and milling machines. This unit provides a higher range of speed which is required for the smaller sizes of end mills and drills. The driving shank of the head is furnished with a No. 5 Morse taper which makes it adaptable for use in all boring mills and milling machine spindles. The spindle in the high speed head is furnished with a No. 4 Morse taper which represents the most popular size for end mills, drills, and chucks.

The step-up ratio of the head is four to one over the spindle speed of the machine. The unit is designed for a top speed of 1,500 r.p.m. on the high-speed milling spindle and has a maximum capacity of 1 in. diameter end mills and 1 in. diameter drills in steel. The body of the milling head and the driving shank are of one-piece construction. The high speed spindle is mounted in the body of the milling heads by means of precision tapered roller bearings. The planet idler gears are mounted on hardened pins by means of roller bearings.

A boss is provided on the outside diameter of the milling head and supports a torque bar which engages with another bar mounted on the column of the machine parallel to the axis of the machine spindle. The torque bar attached to the head and the clamp for mounting the parallel bar are furnished with the head. The parallel bar is provided by the customer to meet the requirements of the individual job.

A knockout pin for drifting the end mills and other tools from the high-speed spindle extends through the driving shank so that the tools can be easily removed without removing the milling head from the machine spindle.

Cushman Bench Lathe Chucks

The Cushman Chuck Co., Hartford, Conn., has developed two bench lathe chucks, one a self-centering type of light weight known as the No. 340, and the other an independent four-jaw chuck designated as the No. 140. The guaranteed centering accurarcy for the No. 340 chuck is within 0.003 in. This chuck is 5 in. in diameter and weighs 6½ lb. The chuck body is of semi-steel with its periphery and face accurately ground. High carbon steel is used for the scroll which is formed on special tools for accuracy. The pinion is of chrome-nickel steel, heat-treated, while the jaws are of alloy steel with the teeth especially cut on an automatic machine. After fitting the jaws, every chuck is tested on a true plate with the jaws in at least six different positions.

The No. 140 independent 4-jaw chuck is 6 in. in diameter and weighs approximately 11½ lb. The chuck body is of semi-steel with the face and periphery ground. Graduated reading lines are located on the face. Thrust bearings are carbon steel, casehardened. Screws are chrome-nickel steel with chased square-cut threads for the full length, and are self-cleaning. Jaws are of alloy steel and are reversible. They are interchangeable in complete sets with other No. 140 jaws of the same size.

Brown & Sharpe No. 559 Surface-Plate Square

A No. 559 surface plate square has been included in its line by the Brown & Sharpe Manufacturing Company, Providence, R. I. The square has both ends square with the sides and is of a form convenient for use as a surface plate. The one-piece construction is not subject to changes from handling and from small variations in temperature. The weight and shape are such that the square is not easily upset. It is made of hardened steel 4 in. high and is approximately 3 in. between opposite edges.

Wardwell No. 35T Automatic Saw Grinder

For the sharpening of milling, slitting and screw-slotting saws, the Wardwell Manufacturing Co., 3161 Fulton Road, Cleveland, Ohio, is introducing a No. 35T automatic saw grinder. A gang of saws is lined up on the arbor and ground completely at one setting. The machine automatically indexes the gang, one row of teeth at a time, and the grinding is done with a wheel of suitable thickness and of proper shape to sharpen the tooth point and to gum the throat in one operation. The reciprocating slide is operated by an adjustable eccentric, permitting a stroke up to 3 in. Saws are automatically fed at a speed of 28 teeth per min. by a 5-in. index plate. Capacity of the grinder is from 2 to 5½ in. in diameter with tooth spacings up to ⅜ in. from point to point. The saw arbor has a capacity for holding saws up to 1¾ in. in thickness. Either belt or motor drive can be furnished.

A 6 x ⅞-in. grinding wheel is employed, and a diamond dresser which is adjustable to any angle, can be furnished with the machine.

Stainless steel is used for the working parts of the Starrett Dial Indicator. Case and bezel are chrominum plated. Dials are easily read

Starrett Dial Indicators

The L. S. Starrett Co., Athol, Mass., has added a line of dial indicators in which stainless steel is used for the gears, rack, dowels, screws, stem, bushings, while the case and the bezel are chromium plated. The back is a solid die-casting, recessed to hold the lug for clamping the indicator to tool spindles, machinery, production jigs or fixtures. The lug is attached on or off center as desired and can be turned parallel or at right angles to the direction of the spindle. Sapphire jewels are used to give the gage mechanism a smooth watch-like movement. The dials are finished with a special easily cleaned enamel and are marked with bold black figures against a clear white background. The crystal is non-breakable. Among the indicators available are models reading in thousandths, half-thousandths, ten-thousandths, hundredths of a millimeter and five-hundredths of a millimeter, including gages that show both plus and minus measurements. On all indicators the dial may be moved and locked to bring the zero mark to any point in relation to the hand by means of the knurled bezel and clamp.

• TRADE • PUBLICATIONS

ABRASIVE WHEELS. The Bakelite Corp., River Road, Bound Brook, N. J., have issued a booklet "High Speed Abrasive Wheels Bonded with Bakelite Resinoid." The booklet shows the part played by resinoids as binders for grinding wheels used on many different kinds of work.

BEARINGS. The Bantam Ball Bearing Co., South Bend, Ind., has issued a catalog on straight roller, radial and thrust bearings, giving complete list of dimensions on capacities in both inch and metric sizes for radial roller bearings, as well as the other types described.

BEARING BRONZE. Aluminum Industries, Inc., Cincinnati, Ohio, has published a folder on "Permite" leaded-bronze bearing stock now available in standard 6 ft. lengths.

CHAINS. Folder 1460 released by the Link-Belt Co., 910 South Michigan Ave., Chicago, Ill., describes ⅜-in. pitch, silent chain drives and gives installation pictures, and horsepower and pitch diameter tables not previously available.

CHUCKS. Bench lathe chucks in a self-centering type and in a 4-jaw model are described in Bulletin No. 134 issued by the Cushman Chuck Co., Hartford, Conn.

ECONOMICS OF MACHINERY REPLACEMENT. The Virginia Polytechnic Institute, Blacksburg, Va., has published a bulletin entitled "The Selection and Replacement of Manufacturing Equipment —A Discussion of the Economic Factors," by Paul T. Norton, Jr., professor of industrial engineering. Copies are free as long as the supply lasts. This economic study is expressed in such a way that it can be used by industrial executives who have not made an exhaustive study of the fundamental theories. The bulletin recommends an orderly tabulation of individual and total charges, such as shown, rather than the use of replacement formulas that may be imperfectly understood.

GEARS. Under this title the Philadelphia Gear Works, Erie Ave., and G St., Philadelphia, Pa., has published a 48-page, 8½x11 in. catalog on such gears as: Spur, worm, herring-bone, internal, bevel, miter, intermittent, spiral, helical, continuous tooth herringbone, spiral bevel and hypoid bevel. The catalog includes non-metallic pinions, speed reducer units, motor reducers, electric hoists and a limitorque valve operator. Miscellaneous items shown are silent and roller chains, sprockets, flexible couplings, racks, universal joints, ratchets and pawls.

GRINDERS. Catalog No. G-34 describes the internal and external hydraulic race grinders, built by the Landis Tool Co., Waynesboro, Pa. Extensive descriptive and photographic treatment of these two machines has been undertaken.

HYDRAULIC MACHINERY. The Hydraulik G.m.b.H., Duisburg, Germany, has taken its 25th anniversary as the occasion for publishing a jubilee edition of the "Hydraulik-Review," showing early and modern models of hydraulic machines, principally in very large sizes.

MACHINE PARTS. The Struthers-Wells Co., Warren, Pa., has published Bulletin M-13 discussing welded machine parts of all commercial metals. The company furnishes technical advice as well as making welded parts.

MONEL METAL AND NICKEL. A booklet "The Application of Monel Metal and Nickel to Industrial Processing Equipment," the data being revised as to July, 1934, is available from the Editorial Department, The International Nickel Company, Inc., 67 Wall St., New York, N. Y.

MACHINERY. List No. 83 of rebuilt machine tools in stock has been published by the J. L. Lucas & Son, Inc., Bridgeport, Conn.

MACHINERY STEEL. The Crucible Steel Co. of America, 405 Lexington Ave., New York, N. Y., has published a catalog section on machinery steels. The section shows the various grades of "Max-el" steel and special grades of machinery steels. A catalog sheet on each type of steel mentions the composition, machineability, physical properties, range of sizes in mill stocks and applications. With each type of steel there is shown an industrial product making use of the material and describing the service encountered.

MILLING CUTTERS. Catalog H, prepared by the Thurston Mfg. Co., Providence, R. I., shows its line of "Thurco" milling cutters, saws and die-milling machines. The sizes of cutters listed are in accordance with the latest simplified practice. Special milling cutters are illustrated.

OXYACETYLENE CUTTING MACHINE. A booklet describing the Airco-DB "Tractograph" is being distributed by the Air Reduction Sales Co., Lincoln Bldg., 42nd St., New York, N. Y. Many photographs are used to show the operating characteristics and the possibilities of this equipment.

SALARY STANDARDIZATION. A report "Salary Standardization and Administration" is the result of a survey made by the Policy Holders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York. It is said that few organizations have attempted to evolve scientific control of salaries as contrasted to that for pay to wage earners.

THE ROUND TABLE

Open Prices

"I see," said Ed as he entered Al's office, "that the government is getting after some of you fellows for price fixing."

"Not after me," disclaimed Al, "or my industry. You're thinking about some of the commodity codes like lumber and sugar. And there's a lot to be said for a firm price control in such cases."

"The best you can say is that in the end the consumer gets soaked," said Ed. "They start out fair enough, but fixed prices become monopolistic in the long run. And high prices have just as bad an effect on purchasing power as low wages."

"I'm not defending them except for emergencies," said Al. "But sometimes it seems to be the only way to keep the chiselers in line."

"And the consumers in line too. But, Al, it seems to me that comparing prices the way that you fellows do is just about as bad as fixing them."

"You're displaying your ignorance now, Ed. We don't compare prices. We have what we call an open price policy which simply means that every concern must file the prices it quotes with the code authority. Any price can be quoted, but it cannot be altered on the same bid and an order cannot be taken for a lower price."

"It amounts to the same thing," said Ed. "Your lowest bid tends to become the set price for the whole industry."

"It does if the price is fair," said Al, "but if there's a big profit in it someone will go lower to get the order. The element of competition is still there which is the important point."

"But I can't see," said Ed, "what's the use of all this posting prices at a central point if you're going to have free and open competition."

"It puts a curb on the unfair seller and the unfair buyer," Al explained. "The man who successively lowers his prices to meet competitive bids is a bad influence. Either his first quotation was padded, or he is taking the business at a loss which hurts both himself and his competitor. Then we have the unscrupulous purchasing agent who pits one bidder against the other, frequently deceiving both of them as to quoted prices. He creates ill will in the industry and demoralizes the price structure by getting it below the profit level."

"It sounds like a noble purpose," said Ed, "but I can't help thinking that the poor public pays in the end."

"The public gains in the end," said Al. "Temporary cheap prices and high business mortality don't help anyone. The consumer is just as much interested in sound business and uninterrupted payrolls as industry itself."

Does an open price policy lead to price fixing? Is the public better off if open prices are barred entirely?

Discussion

Rolling Your Own

As to whether jigs and fixtures can be best made in Al's own shop or in one that specializes in that class of work, depends on circumstances, and good judgment will be required to decide what will be the more advantageous in each case. Cost, quality and time are factors that should govern the decision.

If Al and his men did nothing while waiting for an outside shop to do the work, the overhead in his shop would still be going on, and it is obvious that in such a case he ought to add this overhead to what he pays the other shop in order to get a comparative cost.

Al may adopt rough and ready methods in his own shop to accomplish what he requires, but if he has to transfer his ideas to others, he has to elaborate them to prevent misunderstandings and costly mistakes. On the other hand, the shop that specializes may have designs that are standardized, which may make them of advantage from all viewpoints.

Time in which delivery can be made may alone be the deciding factor. Al can control the output of his own shop, but he may be badly tied up if he trusts to another shop that may be busy on other work and not able to make delivery as and when he wants it. In general, however, we do best by employing others who can do better work for us than we can do for ourselves.

—L. Brown,
Montreal, Canada.

There is an old saying that the safest course is midway between the two extremes. I have found this to be a safe rule when deciding whether to have jigs and fixtures made in the home shop or outside.

Sometimes it is cheaper to have fixtures made in some special shop because its equipment is more suitable and it is

more advisable to let it take the hazard. At other times it is better to "roll your own" because the home men are better acquainted with the particular use to which the fixtures are to be put.

—Ed. A. Baily,
Stanley Manufacturing Company,
Toronto, Canada.

In my opinion Al is right. There is no comparison between making jigs and fixtures at home or having them made by a tool shop that specializes in that class of work. The tool shop has the benefit of constant contact with the latest methods of making jigs and fixtures. It has capable designers, proper facilities and up-to-date equipment.

Assuming that Al could hire a few toolmakers for a short time to make his tools, it is well known that new men on new jobs are not 100 per cent efficient for the first week or two, and this alone should discourage any such procedure.

In charging overhead it is almost impossible to allot to every job its proper share. When a new or strange job is being done it naturally gets the most attention from the foreman, resulting in his slighting other jobs. This is really supervision and should be charged directly to that particular job.

—Robert Knotek,
Assistant Toolroom Foreman,
Fisher Body Corporation.

The Little Fellow's Chance

It is wise to be conservative under any conditions, but the word conservative has been misapplied to cowards and penny pinchers. The real meaning of the word is close to that of preservative, and the preservation of a plant is not linked with either a wild spending orgy, nor with the refusal to spend. The plant, either large or small, that neglects to watch development of equipment can never hope to be anything more than a hopeless sort of tag-along, if it is able to exist at all.

Both Al and Ed have an odd slant on the matter. In a competitive field, success is based on service. Unless Al can sell folks an equal or greater amount of value per dollar than the other fellow, he will lose out, whether his closest competitors be large or small. He will do well to take his eyes off of the big fellows, as he calls them, and to clear his mind from any notions of stepping into their shoes.

Did Al but know it, inexorable laws of economics are always working in favor of the little fellow. With his smaller investment and his more flexible layout, he does not stand to lose as heavily in bad times, and yet he gets a fair and open shot at the market when times are good. —John E. Hyler.

By the Week

Only those who have had experience with both systems of payment can appreciate the difference between the hourly rate and the weekly rate. The average man does not ask a great deal from life. Give him a job and a reasonable standard of comfort for himself and his family and he will be fairly content. Pay him for vacations and for time lost by illness of ordinary duration, and the last worry will be removed from his mind.

There is no reason why weekly pay should remain a privilege of the white-collar worker, for the man in the shop is just as trustworthy as is the man in the office.

For some years I was connected with a shop where no time-keeping check was kept, and where disciplinary measures were unknown. The men smoked and conversed whenever they pleased, but

the privilege was never abused. Under the compulsory state health insurance system in this country, men incapacitated from work by illness receive about $4.50 per week. Nevertheless, the owner of this shop paid them full wages during illness, as he maintained that they required the extra money for invalid food.

This shop paid its way for years, but when the owner died a company took his place. Time clocks were introduced and time rates were paid with no pay for holidays or illness. Most of the old hands went elsewhere and the business eventually failed. Trust your men. It pays! —Roy Vernon Wade,
Glasgow, Scotland.

Discounts

Cash discounts are justified, especially by business operating with limited capital, as an inducement to customers to settle their accounts promptly and to buy more goods, thus making a quicker turnover of inventory. By a quicker turnover at the same profit per turnover, a greater yearly profit can be made. All or a part of this greater profit can be passed along to the customers either through direct reductions in price or by giving better discount terms.

Business with its back against the wall and fighting for its life resorts to price cutting and to beating down the seller, thinking it is getting first-quality goods at second-quality prices. Unfortunately for it, Santa Claus works but one day in the year.

—E. E. Gagnon,
General Manager,
Greencastle Manufacturing Company.

Hourly Pay vs. Piecework

As to whether piecework, hourly rates, or bonus is the best is determined by the nature of the work undertaken. Piecework is fair enough in repetitive work, but where the workman has to exercise his skill and his brain on each individual job it is impossible to set a fair piecework rate. The workman may be working his best and yet exceed his time allowance. Where parts are continually differing in the nature of the work to be done, piecework is not fair to either the workman or the employer.

Piecework rates are difficult to set where skilled work is concerned, and any saving to the employer might easily be wiped out by the waste of the foreman's or the rate-setter's time in setting the piecework rate, and in the foreman's time in the closer supervision necessary. Where part of the work is purely repetitive, piecework rates may be paid to the men doing that class of work. The fairest way of rewarding men who are not on piecework is by a bonus based on the output of the shop. The output would naturally be increased to the benefit of all, and the shop force would be much more contented.

—W. E. Warner,
Garden City, Hertfordshire, England.

The Better Foreman

The foreman's main job is management. He must be diplomatic, and he must be fair in his dealings with the men under him. Natural leadership is a great asset.

A foreman of course is responsible for the work produced by his men, both as to quantity and quality, and he must be able to organize the production so the work goes out on schedule. To do this it is necessary that he knows the line of work he is in particularly well; but he does not have to be an expert workman. In cases where the men employed are highly skilled, as in the machinery industry, the ability as a teacher is of little importance; but when the help is unskilled it is often necessary for the foreman to break his men in, and much depends on his ability to do that.

It is a known fact that the highly skilled workman is more of an artist than a practical man, and he seldom makes a good foreman.

—Nils H. Lou.

American Machinist November 7, 1934

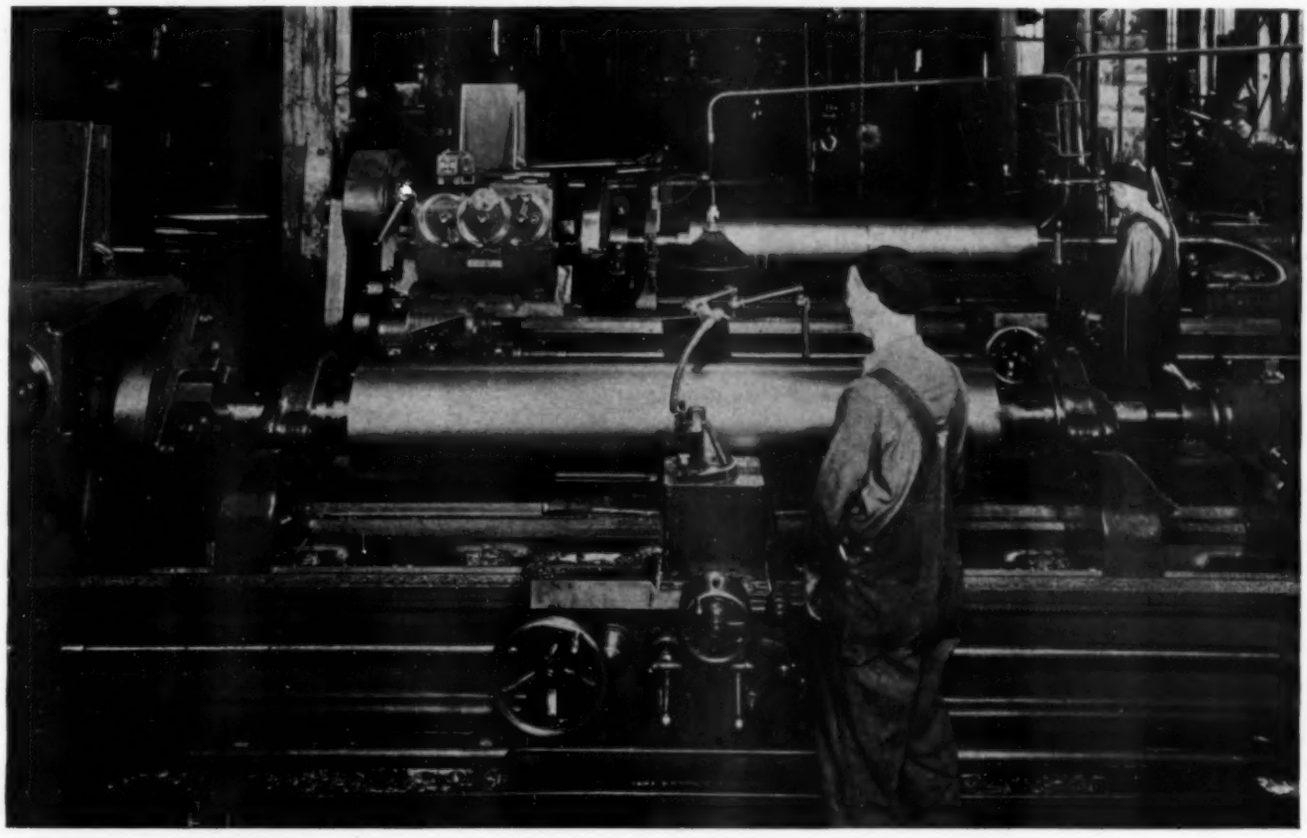


Fig. 1—Two multi-production engine lathes turning steel rolls with an accuracy that eliminated a grinding operation. The one in the foreground turns the body, the other turns the journals

"We Couldn't Afford the Old Machines"

A newspaper printing press builder finds that modern equipment makes impressive savings even on small lots and under present conditions

JOHN M. PATON

Superintendent,
Goss Printing Press Company

MANY manufacturers today are making the mistake of thinking that they cannot afford to install modern production equipment. The future is full of foreboding, the present is insecure, the past is paved with mistakes. Therefore, why even consider putting in replacements that will cut costs?

Since we have had our siege of this gloomy philosophy, and have managed to shake it off, I believe that a statement of our experience with a few modern machine tools which have been purchased during the past year may be encouraging to those who still doubt the wisdom of doing anything but sit tight.

The plant of the Goss Printing Press Company, like the plants of other companies building heavy, intricate machinery, is essentially a contract shop. Only one or two of our smallest presses are built for stock, the rest on order. We can do a certain amount of manufacturing, however, because a big newspaper printing press contains a number of similar units the parts of which can be put through in lots.

When we concluded that it was high time to question our existing methods of machining and grinding to be sure that we were operating economically one of the first operations studied was the finishing of steel plate cylinders. It was standard practice to finish these cylinders by grinding after the preliminary turning operations had been completed. Since the tolerance is 0.0005 in. in a length of 72 in. it was the general opinion that no turning operation would be sufficiently accurate. After considerable experimentation, however, the American Tool Works Company informed us that they had been successful in meeting the

accuracy demanded. We bought two of their 30-in. x 14-ft. Multi-Production roll lathes and assigned one to the turning of the roll bodies, the other to the turning of the journals.

For the journal turning operation, the cylinder is mounted in a suitable driver attached to the face plate, and on a live tailstock center which is mounted in the spindle on double Timken bearings. A steady rest is used to support the center. This operation is being done on the lathe shown in the background in Fig. 1. The coolant has been turned off on both lathes to help the photographer.

For the body turning operation, shown in the foreground of Fig. 1, the turned journals are mounted in pillow blocks supported on the lathe bed. The material of the rolls is 0.35 to 0.45 carbon steel, and with cemented carbide tools surface speeds of 250 to 400 ft. per min., with feeds per revolution of 0.040 in. for roughing and 0.015 in. for finishing have been reached. We are operating successfully with Vascoloy-Ramet tools, and saving 40 per cent over our former turning time.

These plate cylinders are finished with sufficient accuracy to permit the elimination of the formerly used subsequent grinding operation. The impression cylinders, however, have two ¾-in. slots staggered at 90 deg. and 32 in. from each end. Since these slots are opened up before the turning operation they cause an interruption in the cut which has made it advisable to slow down the speed of turning and increase the feed to about ⅜ in.

In this case it was not possible to do away with the grinding operation for finishing, but the new equipment was enough better than the old to make possible a reduction of two hours in grinding time.

Another lathe job on which considerable savings have been made is the turning of the cast iron roll shown in Fig. 2. This roll is 72 in. long and 14 in. in diameter. It is roughed in about 10 min. on a Le Blond Heavy Duty engine lathe using Stellite-J tools both front and rear as illustrated. The old time was 60 min.

Another installation, which was even questioned by the builder of the equipment because of the small size of the lots, was the battery of four Foster "Fastermatic" chucking machines. As illustrated in Fig. 3, these four machines, all differently equipped, are arranged in a hollow square to be handled by a single operator. They are served by overhead tramrails meeting in a welded turntable which was constructed in the shop, and carrying a hoist. We have been able to show appreciable savings in this battery on lots as small as 10 pieces.

Two platen type machines and two with indexing turrets were selected to give maximum flexibility, and standard

Fig. 2—Heavy-duty engine lathe roughing cast-iron rolls. With tools in both front and rear tool blocks the old lathe time of 60 min. has been reduced to 10 min.

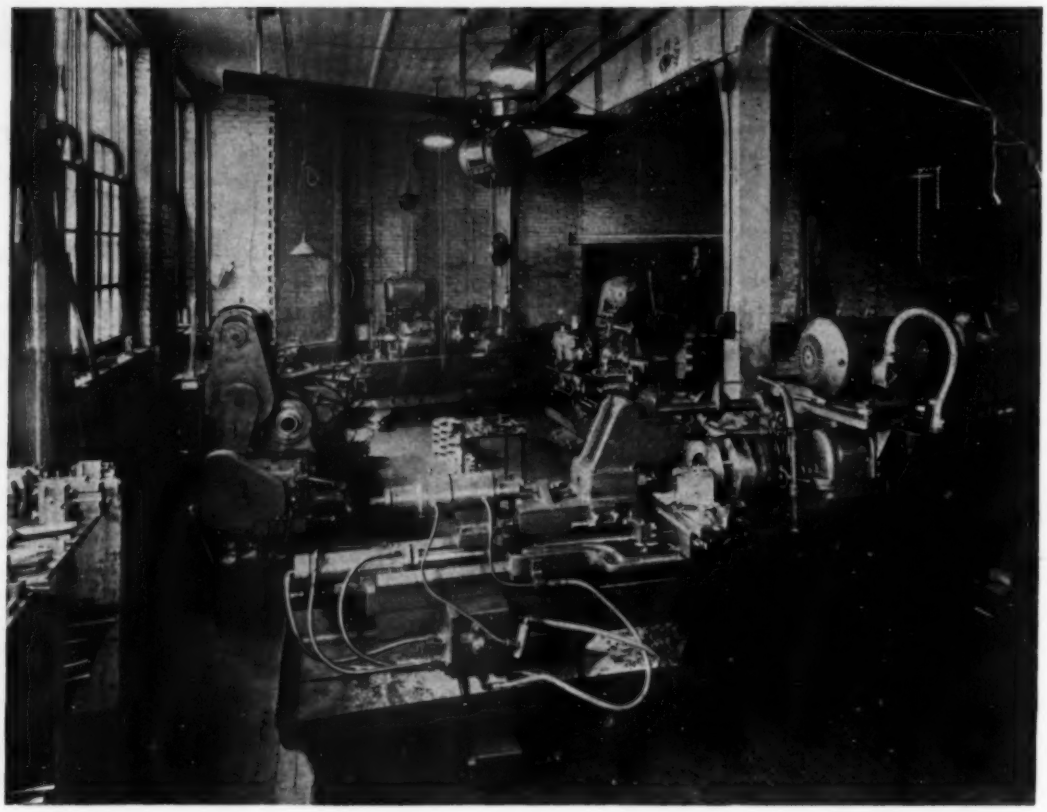


Fig. 3—Battery of four chucking machines served by tramrails and turntables carrying a hoist. One operator handles the battery which has accounted for real savings on lots as small as 10 pieces

tooling is used as far as possible. The automatic speed change heads which provide proper spindle speeds for each operation reduce machining time to a minimum. Spur and bevel gear blanks, and analogous pieces, make up the bulk of the work done by this battery. Savings of 40 per cent are typical.

In the drilling department the American "Triple-purpose" radial drill shown in Fig. 4 is reducing former drilling costs from 30 to 40 per cent. It is driven by a 15-hp., 3 to 1 adjustable speed, d.c. motor, with speed adjusting rheostat and control on the head. The column is mounted on a special base large enough to accommodate the side frames of our presses. At one side of this base is a pit, and in this pit, as illustrated, is a vertical table for mounting work that must be drilled in a vertical position.

A 40 per cent saving over any previous method has been achieved by the Newton universal planer type milling machine shown slotting rolls in Fig. 5. The roll is made of forged steel. Of the seven motors applied to this machine four drive the four heads, one elevates the crossrail, one traverses the two vertical heads, and one feeds the table and the two side heads. In addition to slotting the machine performs milling and routing operations.

For the job shown the two vertical heads are slot milling the roll. The lower ends of the arbors are supported by brackets clamped over the extended

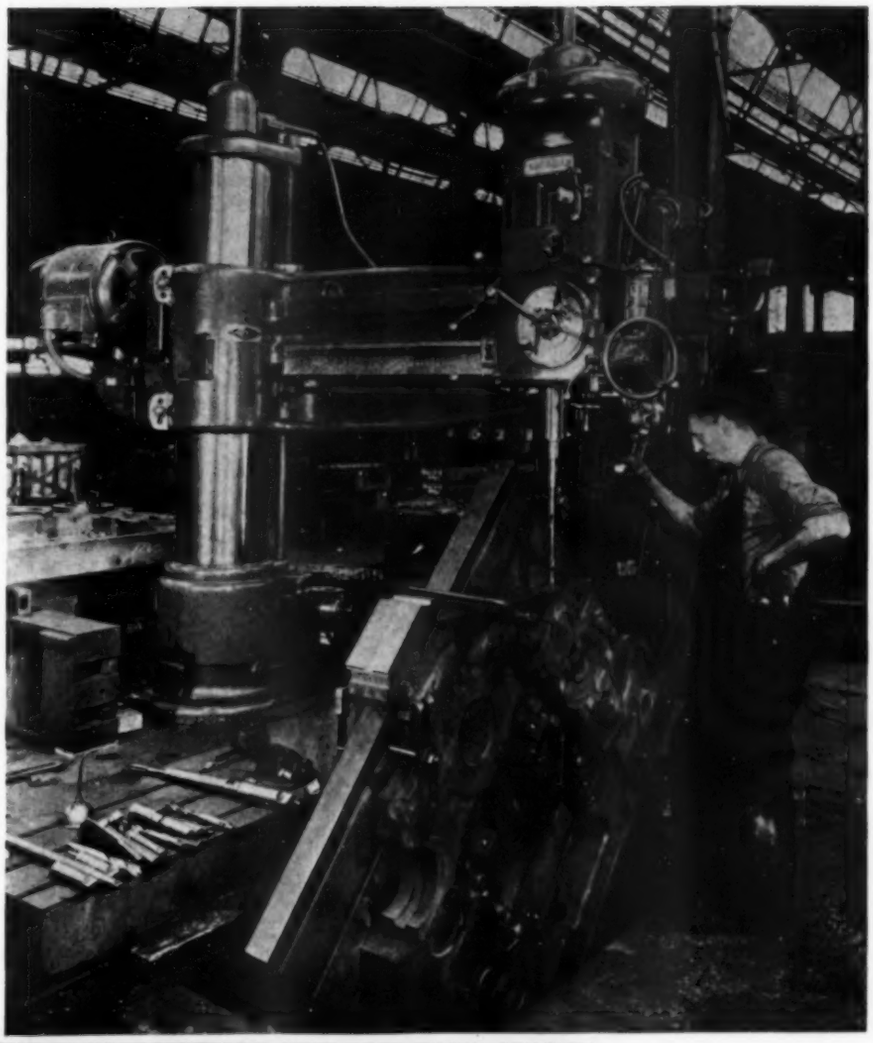


Fig. 4 — Radial drill equipped with special table for supporting work in a vertical position. Drilling costs have been reduced from 30 to 40 per cent for various jobs on this machine

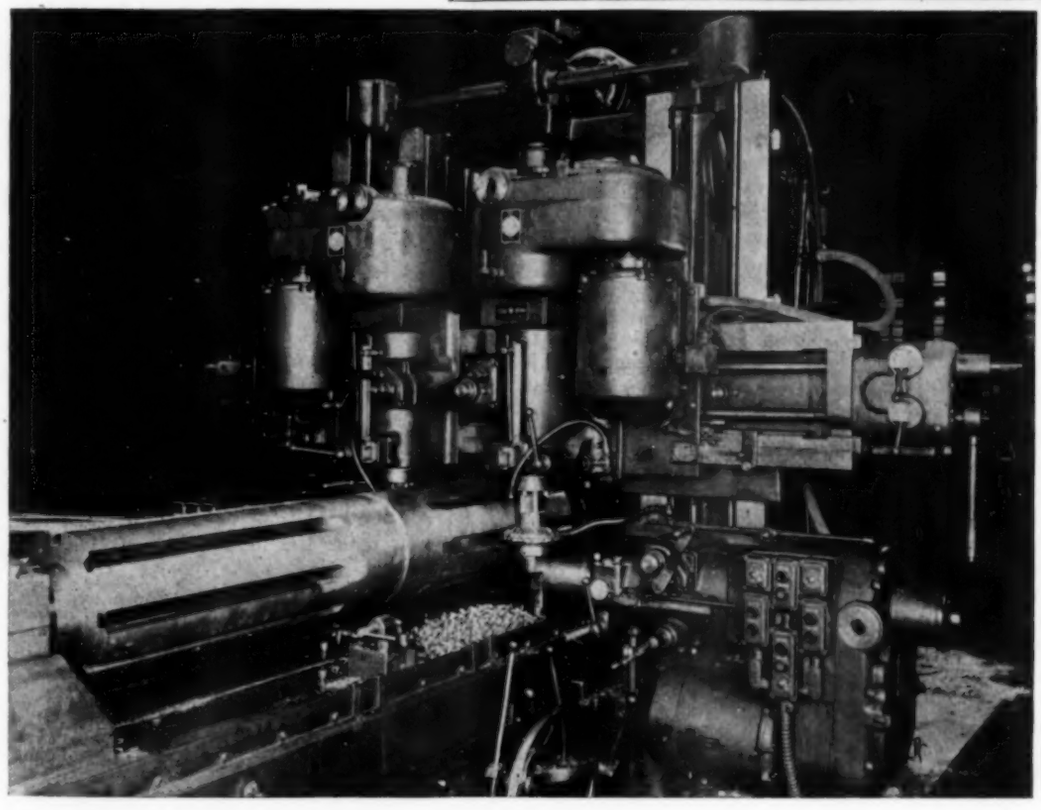


Fig. 5 — Four-head planer type milling machine milling slots in steel rolls. Pilots are supported by brackets clamped to side heads. Savings of 40 per cent over old methods have been made

sleeves in the horizontal heads, and all four heads are clamped in position with the table feeding against the cut.

The operations I have mentioned and the machines shown in the illustrations are the more important ones to be affected by our modernization program. We have been so gratified at the reductions in production cost made possible by up-to-date machine equipment that we propose to continue the process as funds are available and as opportunities to save cost are discovered. We are confident that the depression in the machine tool industry would soon be over if other potential purchasers would scan their equipment and methods in like fashion. We couldn't afford to keep the old machines and we don't believe they can either.

An Economy of Plenty

MEN IN the machinery industry have always believed, although most of them would have had hard work putting their beliefs into words, that the results of their work spelled relief of the masses from drudgery, and more of the good things of this world for everybody. They had to take a lot of the blame for a depression that was not their fault, because their critics were either unable to realize that the old economics of scarcity no longer applies to current conditions, or else were playing politics. They needed a spokesman to explain the principles of the economics of plenty, and now they have him in President Glenn Frank of the University of Wisconsin.

In his new book, "America's Hour of Decision," which has just been published by Whittlesey House, McGraw-Hill Book Company, Inc., New York and London, he presents the case for mass production and distribution to the end that the standard of living of all may be raised. In his introduction he says that America must choose between a continuation and development of our basic philosophy that "democratic self-government, wisely adapted to the diversities of national temperament and tradition and progressively adjusted to the changing circumstances of succeeding generations, was a climactic point in political evolution," and "a frantic search for new foundations of national being."

In this "frantic search" Mr. Frank says that "Democracy is flouted. Freedom is invaded. Plenty is renounced. Science is betrayed. Education is hamstrung. Religion is tied to the cart tail of the state. Nationalism runs amuck. While politics, as it assumes greater and greater power over our lives, is expressed, not in that sobriety of thought and steadiness of action the time demands, but in distracted agitations."

Dr. Frank's first chapter, "The Temper of the Crowd," is one of his best. For instance, "the peculiar nature of an age of science, technology, and power production is such that it can be kept a going concern only as the human needs of the swarming millions are served adequately. The business of a mass-production age cannot but backfire if a philosophy of the few dominates it. The market of a mass-production age dies if the masses lack ample leisure and adequate income. Only through such mass leisure and mass income is mass consumption possible on anything like the scale our productive capacity indicates. The crowd is in control. Science and the machine, not the agitators, have put it in control."

And this, "Traditions and folkways that have long served as the stabilizer and scaffolding of men's lives are subjected to a sweeping skepticism that has gone beyond the critical confines of the intellectualists to give direction to the uncritical reactions of the mass mind. Where once men's minds were certain they are now cynical. Where once men were animated by a buoyant confidence that human genius was equal to the conquest and control of nature, human nature, and social organization despair now darkens their outlook. Where once great binding beliefs held peoples together in a saving sense of solidarity they now disintegrate into a sordid scramble of individual and class interests. Where once men but criticized the functionings of their major social institutions they now challenge their foundations. Where once men went for guidance to the sober assessments of philosophy they now lend a ready ear to the theatrical screams of passion. In the face of the manifest possibility of plenty in this age of science, technology, and power production, a heightened resentment of wide differentials of wealth arises. We witness a resurgence throughout Europe of the gospel of equality. And hitherto docile masses everywhere seem set to take affairs into their own hands or lodge them in the hands of leaders who speak their language of urgency. . . . Any leadership that cannot and does not deliver a workable economics of plenty will be unable to retain power if the millions are left with their political leverage."

The chapter called "Plenty Renounced" is the one that is of most interest to the machinery industry. In it he outlines his "Economy of Plenty." Here are snatches of it. "For the better part of a generation, we have been working in terms of an age of plenty, but thinking in terms of an age of scarcity. Our enterprise has been new. Our economics has been old. The transient prosperity of the twenties threw the mantle of a bright delusion over this dangerous maladjustment between our enterprise and our economics. But events are rapidly joining the issue. We shall have to decide, without undue delay, whether we are to explore further the possibilities of this age of plenty or execute a return to an age of scarcity. We cannot go on indefinitely with our enterprise in one age and our economics in another. We must either shove our enterprise back to our economics or bring our economics abreast of our enterprise.

"To me, it is incredible that, in a world of tragically unfilled human need, we should now set out upon the Quixotic attempt to increase welfare by destroying wealth or declining to create it. Our ancestors fought valiantly over the centuries to conquer famine. Are we now to say that their conquest has been too decisive? After the sweat and science of generations have brought us out of an economy of scarcity into an economy of plenty, are we to confess that we are incapable of managing plenty, and deliberately legislate modified famine in just those areas of our enterprise where production has proved most efficient? I think history will pass a bitter judgment upon us if, in the midst of such manifest need, we take this road."

The Job of the Future

As for the future, "A business and industrial leadership that will take as its job the conquest of poverty and qualitative famine, as I have here defined them, will open up the biggest new market we have yet known, solve such problems of surplus as exist, realize, even on a narrowed profit margin, larger total profits than it has dared imagine, and make the industrial giants of yesterday seem dwarfs.

"The achievement of these ends requires, as I have suggested, that we turn our backs decisively upon any idea of a retreat to an age of scarcity, and that we deliberately construct an economics of plenty in consonance with the prolific productivity of this age of science, technology, and power production."

Care of Railway Air-Conditioning Apparatus

R. E. MARKS

Precautions taken at the proper time will usually avoid trouble in this type of equipment

THE INCREASING use of air conditioning apparatus on railway trains adds another item to the growing list of mechanisms that must be kept in order by the maintenance department. Fortunately, most of the air conditioning apparatus consists of simple units which require but little attention. For this reason it is common practice to put them in charge of the same men who take care of lighting and heating equipment. The only objection to this is that these maintenance crews have been reduced to mere skeletons on many roads and do not have men enough to handle properly the little work necessary.

Types in Use

There are several types of air conditioning apparatus in use including tanks of ice, steam ejector systems and compression units such as used in household and commercial refrigerators. While these differ widely in construction they all have coils of piping and their connections which must be kept clear and tight, filters and strainers which must be kept clean, and pumps and motors which must be maintained in working order. Besides the cooling or refrigerating unit there is the air conditioner in which the air is cooled or heated with the proper control of the humidity, or amount of moisture in the air, but this only adds another unit rather than a different problem in maintenance. Motors, pumps, control and reducing valves, strainers and piping are probably the main items to be considered. The steam ejectors used with some systems have no moving parts and only need to be kept free from obstructions of all kinds. This is taken care of by strainers. In certain districts where water has a large percentage of lime this may form a deposit in the pipes and ejector nozzles. The low temperatures used, however, make this much less of a hazard than is the case with injectors for boiler feeders.

As keeping pipes and strainers clear is one of the important items of maintenance it is important to select a system which has been designed with convenient provisions for blowing out pipes and for removing any accumulation of dust or sediment from air filters or pipe line screens. Some consider it advisable to have regular cleaning dates while others wait until there is some indication that cleaning is necessary. When cleaning the filters it is also advisable to blow out any dust that may have accumulated on the coils of pipe used in the apparatus.

Motors used to drive circulating pumps require little attention as they are usually of the low voltage type common in car lighting work. The usual voltage is 30 so as to obtain light and power from a 16-cell storage battery in series. This low voltage requires a long commutator and large wiring as well as special lamps. The use of 60 volts is advocated by some with long experience, both to reduce the amount of copper in conductor wiring and to permit a more compact commutator. This would require no change in the insulation of the commutator or other parts as all apparatus is now tested to "double the voltage used, plus 1,000 volts," the constant of 1,000 providing a huge factor of safety. One road is making a drastic change in its voltage, jumping from 30 to 110 at the lamps. They will use axle-driven generators of 150 volts to charge their storage batteries. As the 30-volt lamps are said to be superior to the commercial 110-volt bulbs, this phase of the change may have drawbacks.

Keep Packings Tight

Motors require little attention except for occasional cleaning of commutators and brushes as well as brush replacement. Ball bearings are almost, if not entirely, universal and lubrication troubles are at a minimum. Pumps, which are usually of either the turbine or centrifugal type, must be kept tightly packed against leakage. Ingenious packing designs, large packing chambers and spring-controlled packing glands have reduced this phase of maintenance to a minimum.

Copper tubing with substantial fittings and all joints carefully soldered or brazed almost entirely removes the danger of leakage. If leakage does occur it is usually in the connections and piping outside of the air conditioning apparatus, this part of the work usually being done by the railroad itself.

With apparatus which involves the use of small pilot valves, or where special valves must be used to maintain different pressures in some parts of the system, it is advisable to inspect such valves at frequent intervals. Small particles of foreign matter can interfere with the working of a pilot valve and prevent proper functioning of the whole apparatus.

As an indication of procedure recommended for care and maintenance we quote from the bulletin of the Carrier-Safety System using steam ejector equipment.

At Weekly Intervals, or Oftener if Conditions Require, the Following Should Be Done:

1. Drain and flush make-up water tank.
2. Remove and clean strainer in make-up water tank or sump of underframe refrigerating unit as the case may be.
3. Drain and flush sump of underframe refrigerating unit if this type is used.
4. Clean fresh air filters.
5. Clean refrigerating unit inlet screen, in roof mounted unit, or air filters in bottom of underframe refrigerating unit.

About Once a Month:

1. All of the motors should be given a thorough inspection, cleaning the commutator when necessary, freeing any brushes which are tight in the brush boxes and applying new brushes where necessary.
2. Pump packings should be inspected and renewed where necessary.
3. Condenser spray nozzles should be inspected and cleaned if a full spray is not obtained.
4. Clean strainer in steam line to the ejector steam control.

Test Procedure

1. If Pilot Lamp Does Not Light:

a. Insufficient train line pressure indicated by steam pressure gage.—*Signal engineer for more pressure.*
b. Hand-operated steam control valve closed.—*Open valve.*
c. Strainer in steam line clogged.—*Clean strainer.*
d. Pressure reducing valve in need of cleaning or adjustment.—*Clean or adjust valve.*
e. Steam trap not operating.—*Clean.*
f. Steam pressure switch inoperative.—*Clean contacts.*
g. Lamp burned out.—*Insert new lamp.*

2. If Motor-Operated Steam Supply Valve Does Not Open:

a. Insufficient steam pressure after reducing valve, indicated by pilot lamp not being lighted.—*See* 1.
b. Insufficient vacuum in condenser, indicated by condenser pressure gage; should be 20 inches or more.—*See* 3.
c. Condenser pressure or steam pressure switches not making contact.—*Clean contacts.*
d. Open circuit to motor.—*Repair.*
e. Car temperature below thermostat setting.—*Lower thermostat setting.*
f. Valve mechanism sticking.—*Probably due to tight valve stem packing: loosen.*

3. If Condenser Pressure Does Not Fall Rapidly Enough to Close Condenser Pressure Switch and Turn on Steam in 8 to 15 Minutes After Starting Operation:

a. Low Voltage.—*Increase.*
b. Insufficient water in make-up tank.—*Fill.*
c. Condenser pump running slow or not at all.—*Check voltage and motor.*
d. Leakage in vacuum system.—*Stop operation and time loss of vacuum. If at greater rate than 1 inch per hour try to locate leak in cold water pump packing, automatic stop valve, steam supply valve seat, drain valves and piping.*
e. Car thermostat contacts open.—*Lower thermostat setting.*
f. Purge nozzle clogged.—*Clean.*
g. Condenser sprays clogged.—*Clean.*

4. If Refrigeration Does Not Start Within 15 Minutes After Condenser Pressure Switch Closes:

a. Insufficient steam pressure.—*See* (1) *and* (2).
b. Low voltage.—*Increase.*
c. Condenser pump and fans running slow or not at all.—*Inspect motors and fuses.*
d. Outlet dampers not open.—*Inspect operating mechanism.*
e. Low water level in cold water system.—*If this level does not gradually rise, introduce water as described elsewhere.*
f. Air circulating fans not operating.—*Inspect motor and fuses.*
g. Condenser sprays clogged.—*Clean.*

5. If Refrigeration Is Lacking With Full Vacuum—27 Inches to 29 Inches—on System:

a. Low voltage.—*Increase.*
b. Low steam pressure.—*See* (1) *and* (2).
c. Cold water pump running slow or not at all.—*Inspect motor and fuses.*
d. Low water level in cold water system.—*See* 4-*e.*
e. Air circulating fans not operating.—*Inspect motor and fuses.*

What Size Tungsten-Carbide Tips?

Much of the success of tools with tungsten-carbide cutting tips depends on selecting the proper size and kind of shank, and using a tip large enough to stand the cutting pressure without danger of breaking. On the other hand the cost of tungsten-carbide tips make it imperative for users not to order them larger than necessary.

Then, too, experience has shown that shanks, or holders, must be of sufficient size to support the tips rigidly. Instead of low-carbon steel, makers of tungsten-carbide tips advise that shanks be made of high carbon, tool steel both because of its stiffness and because it brazes very satisfactorily. The brazing temperature, however, produces a growth of grain size and in work requiring heavy tool pressure, special steels are recommended for tool shanks. One company uses SAE steel No. 2340 for shanks with good results.

While many tungsten-carbide tips are made for tool holder bits, makers prefer to have them used on solid shanks, as these shanks provide better support for the cutting edge. The tool bit necessarily extends from its holder and this overhang permits more vibration than where the support runs down to the tool post or tool block itself.

Makers of tungsten-carbide tips have standardized the sizes to a considerable extent. While these sizes are not universal to the extent that all tips of different makers are the same size, they are not far apart in general dimensions. The smallest regular tip for turning tool bits is $\frac{3}{32}$ in. thick, $\frac{3}{32}$ in. wide and $\frac{3}{8}$ in. long, while for solid turning tools the thickness is the same but the width is $\frac{1}{16}$ in. The length varies with different makers, $\frac{7}{8}$ in. being the minimum for solid bits in one case. The thickness varies with the work to be done.

Solid turning tools with $\frac{1}{2}$ x 1-in. shanks are made with tips $\frac{1}{16}$ x $\frac{1}{4}$ x $\frac{3}{4}$ in. by one company, and $\frac{1}{4}$ x $\frac{1}{16}$ x $\frac{7}{8}$ in. by another. Tools with 1 x $1\frac{1}{2}$-in. shanks have tips $\frac{1}{16}$ x $\frac{1}{16}$ x 1 in. in one case and $\frac{3}{8}$ x $\frac{5}{8}$ x $1\frac{1}{8}$ in the other. With shanks 1 x 2 in. the tips are $\frac{3}{8}$ x $\frac{1}{2}$ x 1 in. and $\frac{1}{16}$ x $\frac{5}{8}$ x $1\frac{1}{4}$ in., respectively.

While these sizes vary slightly, they give a general idea of the sizes of tips that have been found most satisfactory in general work. In comparing prices of tools it should always be remembered that the size of tip largely governs the cost.

How Many Gadgets?

R. V. HUTCHINSON

Discussing John Godfrey's subject under the above heading, (*AM*—Vol. 78, page 519) the answer seems to be, "Just so many of such variety as will give good service, pay for themselves, and show a profit on part of a machine installed in my shop."

A trend may have developed toward overlooking, to some extent, the requirements of the small-lot shop, in the evolution of certain types of machine tool. The small-lot man needs "rangy" machinery, designed to facilitate ease of set-up, adjustment, changing of tools, all at a reasonable price. Metal removing capacity may be somewhat sacrificed in favor of the above items, though the allowable sacrifice diminishes as work size increases. His ratio of elapsed set-up and tool changing time to elapsed productive time is naturally much higher than that of the repetitive manufacturer.

Fortunately it is still possible to obtain basic machine tools subject to modifications which may be readily made either before or after delivery, and the auxiliary extras obtainable are as few or as many as one desires to buy.

New English Locomotive

With a separate engine for each of its six axles, a new type of steam locomotive has been ordered by the London and North-Eastern Railway Company, according to Industrial Britain.

The locomotive is mounted on two six-wheel trucks and is provided with a three-drum water tube boiler having a working pressure of 550 lb. per sq.in., from which steam is supplied to six compound two-cylinder engines, one of which is geared direct to each of the six axles. It is claimed that in addition to economy in fuel consumption, steam can be raised in less time than with other types of locomotives.

Electronic Inspection

R. D. McDILL
Industrial Electronics Engineer

Describing equipment used in expediting inspection processes and giving examples of practical applications

ELECTRONIC tubes are establishing themselves so rapidly in industry as aids to rapid inspection that there is a demand for devices that will make their capabilities generally applicable. There are many such devices on the market but they are generally limited to only one of the several functions which can be performed by the electronic tube. My purpose here is to describe a combination unit that permits the tube to perform several functions, and by so doing to indicate the various types of inspection operations that can be done electronically.

The principal functions of an electronic relay may be listed as (1) Photo-electric; (2) Capacity; (3) Touch, and (4) Grid Break. Since these designations mean little in themselves they can be described thus:

(1) Photo-electric. When a light beam is intercepted it will cause a relay to make and/or break a circuit.

(2) Capacity. When a body comes into a close space relation with a metal plate, and both the body and the circuit are grounded, a discharge will occur through the intervening dielectric and cause the relay to make and/or break.

(3) Touch. When the floating grid of an amplifier tube is connected to ground the grid loses its control over the plate circuit and allows current to flow through a relay, making or breaking a circuit.

(4) Grid Break. If in an electronic circuit we impress on the grid a high voltage, we will prevent current flowing in the plate or relay circuit. If we break mechanically the grid circuit which is high in voltage for an infinitesimally low current, we unblock the tube and allow current to flow in the circuit operating the relay.

The terminal board of the combination unit for performing these functions is shown diagrammatically in Fig. 1. Let us see what can be done with such a unit.

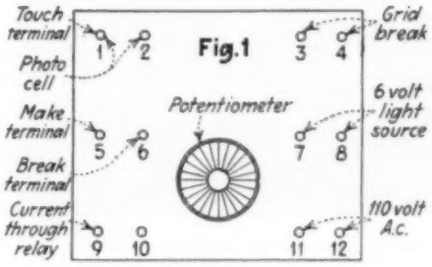


Fig. 1—Terminal board for combination electronic relay unit

Referring to Fig. 1, terminals 11 and 12 are used to heat the tube filaments and supply power to operate the sensitive relay inclosed in the unit. This will require connection to a source of alternating current of 100 to 120 volts, 50 to 60 cycle a.c., or with suitable step-down transformer, to a source of 220 to 230 or 440 volts a.c. current.

Terminals 9 and 10 are used to connect to the contact of the sensitive relay the kind of current which it is desired to switch through the relay. Ordinarily where the switching is a simple contactor of larger carrying capacity than the sensitive relay, a set of jumper wires connects 11 to 9 and 12 to 10. Terminal 9 is then used as the center of the relay output and the make side connected to terminal 5 or the break side of the relay connected to terminal 6 in such a way that the unit can be operated normally closed or normally open on any kind of current or voltage which it is desired to put through the contact of the sensitive relay. These sensitive relays will take up to ½ amp. inductive or 1 amp. non-inductive current of as much as 220 volts.

Photo-electric operation requires a light source that can be concentrated into a fairly narrow beam. Probably the simplest and cheapest available apparatus is the ordinary automobile spot light. This requires a 6-volt filament supply which we will provide across contact 7 and 8.

Contact 3 and 4 should have a jumper wire connecting them. This is the grid circuit and when this connection is broken, the relay closes. Very little current would be carried through this wire as the resistance would run into several megohms. The current flowing therefore would be less than a millionth of an ampere, but the lead would be so sensitive that a break in the circuit of half a millionth of an inch would cause the relay to operate.

Terminal No. 1 would be the touch terminal, and would constitute a capacity switch. When this terminal or a wire leading therefrom is touched by the finger or by an object grounded through a high impedance it causes the relay to operate. By adjusting the potentiometer to a critical point this function can be made highly sensitive. For example, a contact can be run through a metal foil on a glass and the holding of the hand close to the other side of the glass will cause a breakdown of a blocking current in the unit which will make the relay operate.

Contact 2 can be used to reverse this operation by adjusting the potentiometer until the relay closes. Touching Contact No. 2 will cause it to open.

Contact 1 and 2 are also used for photo-cell operations, the cathode or plate being connected to terminal 1 and the anode connected to terminal 2. A vacuum type photo-cell must be used for this purpose. A caesium oxide type such as the General Electric Company PJ-22 is preferred.

Now let us consider how this relay can be used in the simplest form of inspection operation, that is, stopping a machine when a wire feed breaks.

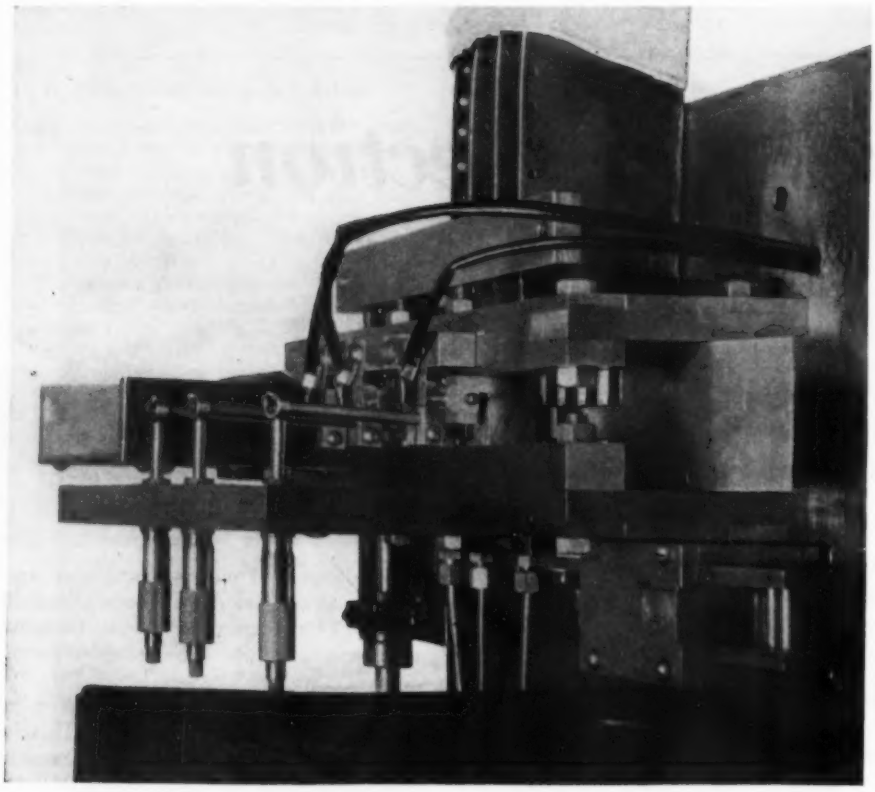


Fig. 2—Automatic electronic machine for sorting bearing rolls

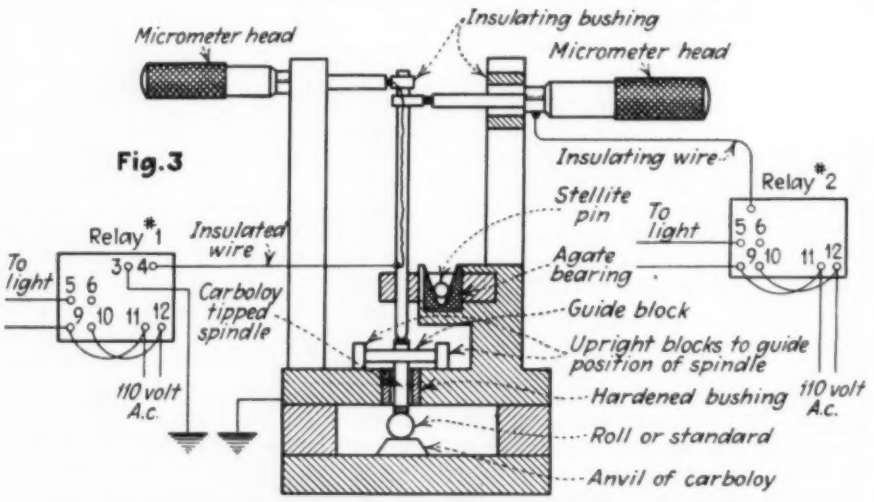


Fig. 3—Diagram of electrical connections for roll gaging machine

Example No. 1: A wire is suspended from insulators under the feed wire and connected to terminal 1. The motor circuit operating the machine is connected to a magnetic switch. The coils of this switch are connected across terminals 9 and 6. When the wire breaks it contacts the touch wire from No. 1 terminal and the relay breaks the contact from the sensitive instrument within the machine. If a quick stop is required a solenoid brake or thrustor brake can be hooked up to another magnetic contactor whose coils are connected to 9 and 5.

Example No. 2. Connect a photo-cell across terminals 1 and 2 and a light source across terminals 7 and 8. Have the wire travel over a space so that it intercepts a slit of light provided by the light source shining into the photo-cell housing. Now connect the motor switch coils across 9 and 6 and the brake switch coils across 9 and 5. When the wire breaks the light turns on the photo-cell causing the relay to operate, thereby shutting off the motor and applying the brake.

Example No. 3. Mount the machine and feed on insulated blocks and connect up the feed wire with terminals 3 and 4 with contact sheaves between these terminals. The same switching operating takes place as in example No. 1. It is obvious, of course, that in example No. 1 a thread feed can be controlled as easily as a conductive wire, simply by suspending by a pulley a fine contact making wire.

It is also obvious that by using two relays in example No. 1 a field control can be used to speed up the machine through a d.c. motor if the wire is slack. This arrangement involves the use of a contact wire close to the bottom of the feed wire, another relay to work in the opposing direction placed over the wire to operate if the wire is too tight, and still a third wire to stop the machine if the wire breaks.

Go and No-Go Gaging

Another use for the type of relay under discussion is in go and no-go gaging. Application of the unit to the gaging of diameters of bearing rolls is illustrated in the electronic gaging machine of Fig. 2.

In this machine the piece to be checked is placed between an anvil and a spindle, the spindle being under spring tension. On top of the spindle and in contact with it is a ball point on a pivoted arm. The pivot bearing is stellite on agate, and the spindle and anvil are of tungsten carbide.

In contact with the other end of the spindle rocker arm is a micrometer spindle for adjustment. Using a 10-to-1 amplification in the rocker arm itself, the micrometer reads ten-thousandths.

We now insulate the micrometer head connected with a touch wire from terminal 1 and adjust the potentiometer to minimum sensitivity. With this arrangement it is necessary for the rocker arm to make actual contact with the micrometer head to operate the relay.

The gage is set with a standard and connections for go and no-go are hooked up as indicated in Fig. 3. Let us suppose that we are selecting 1-in. piston pins with a tolerance of minus 0.00015 in. and plus 0. We first insert a standard of exactly 1 in. in the gaging head and turn the micrometer screw so that the slightest pressure causes the light of the relay to go off. We then remove this standard and substitute a standard of 1.00015 in. and adjust the micrometer head No. 2 until the slightest pressure will cause the light of the relay No. 2 to come on. We are now ready to sort.

A piece is inserted in the gage head. If it is undersize relay No. 1 will stay lighted; if it is oversize, a light will appear on relay No. 2. If the piece is within the limits no light will appear. These lights can be placed over the sorting bin.

This type of gage is accurate to 0.00008 in. when pieces are handled at a uniform temperature and it speeds up the manual inspection operation very materially. In the automatic machine the pieces are caused to progress through a series of gaging heads, using the break method only. The relay operates air valves to eject the pieces between tolerance limits from station to station. In this way rolls for bearings can be rapidly and accurately sorted to within 0.0001 in.

Using the touch wire from No. 1 terminal, this relay has also been used to check the position of a carburetor float in a blind assembly instead of an electrical contact that was dangerous and unsatisfactory. Many uses where a sensitive type of limit switch is required that calls for small physical contact force suggest themselves.

Automatic weighing can be accomplished by mounting the touch wire to contact the scale beam. In a dial scale a hole is drilled through the glass and so arranged that the pointer can contact a light air spring. Where extremely accurate weighing is desired, two relays are used; one operates to close the filling orifice partially and the other to close it completely.

Any dial reading instrument can be converted into an automatically controlled device by the use of two or more of these relays.

Magnetic hammers and screen vibrating solenoids can be made to act at low and variable frequencies by installing the touch wire on the solenoid plunger, limiting the stroke to the desired frequency.

Many other applications of this type of electronic unit will naturally occur to the ingenious engineer. Enough has been given to indicate possibilities.

Are You Spending Too Much for Power?—Discussion

FRED H. ALDEN

Referring to the article by Chester B. Lord under the title given above (*AM*—Vol. 78, page 365), attention should be called to a source of power waste that is seldom appreciated. In many shops the practically limitless supply of compressed air is taken for granted, and it is only when an increase in its use causes a shortage in the supply that attention is called to the matter. Often larger compressors have been installed to provide increased capacity when a reasonable amount of education of the employees would have rendered the expenditure unnecessary.

No attempt should be made to limit the legitimate use of air, but it is one of the easiest services to waste. Fortunately, no great expenditure is required to effect substantial economies. The chief requirements are a couple of hours of personal investigation, plus horse sense and Scotch thrift.

A certain plant had a run of bad luck with its air-operated chucks and fixtures. Several set-ups were wrecked due to insufficient pressure to hold the work, and the remedy appeared to be the installation of an additional compressor. However, investigation disclosed that all the trouble occurred just before the noon hour or just before quitting time.

A check during these periods showed that the unloader remained closed for considerable intervals, indicating that the entire output of the compressor was being used. Quiet investigation located the excessive load in the grinding and polishing department. It was discovered that the men habitually used air to blow the dust and grit off their clothes before noon and before quitting at night. Setting in a solenoid valve automatically to cut off the air from this department at 11.45 a.m. and 4.45 p.m. stopped the waste and made the purchase of additional equipment unnecessary. Personal dry cleaning at company expense was thus eliminated.

In a certain textile mill, air was piped to each motor for periodical blowing the dust from the windings. Here also the cleaning of employees' clothing used considerable air. Furthermore, air hose was sometimes cut to permit the stealing of nozzles and automatic valves, which were sold for scrap metal. Quickly detachable fittings similar to those used for railway air-brake connections were attached to the supply pipe at each motor and the individual lengths of hose were removed. Each maintenance man was given a short piece of hose equipped with a nozzle and mating fitting, which he carried from motor to motor.

A wire mill installed meters on the air lines to the different departments. The cost of compressed air was removed from overhead and was charged directly to the several departments monthly, as per the meter readings. When one of the foremen found at the end of the first month that the charge for compressed air against his department was $270, he took prompt steps to shut off all idle hose, repair leaky fittings and to discipline men who were found using air to excess. Within 60 days the month's charge for air against his department had dropped to $160. The meter investment of $300 showed a return of more than 400 per cent. Tools using compressed air are seldom wasters. The real culprits are leaky fittings and jets which are permitted to blow continuously. At ordinary shop pressure, a ⅛-in. nozzle will blow more than 1,000 cu.ft. of air per hour, costing at least five cents. To save this amount has the same effect as cutting one man's pay five cents per hour, and with none of the kick-back an actual wage cut would incur. A small investment in automatic valves in the air supply to punch presses will pay good dividends. The valves should be set for minimum time of opening, as a single brisk puff of air will blow work from the die as effectively as will a long blast. In setting up a new job, care should be taken to see that the ram adjustment has not put the automatic valve out of time. The entire purpose of the valve will be defeated if the adjustment of the ram permits air to blow continuously when it is at the top of the stroke and the press is idle.

In employing air jets, the smallest possible nozzles that will do the work should be used. A ⅛-in. nozzle uses but little more than half the air used by a ¼-in. nozzle. Shut-off valves should be put where they can be easily reached. Sectionalizing valves should be put in main lines, so that the air supply to groups of machines or to entire departments can be shut off at night. This is important where the compressor is operated 24 hours per day. It is not unusual for leaky fittings and leaky valves to waste as much air as the entire useful load, and for this reason it is often economy to install small individual compressors for machines in isolated locations. The saving of leaks in long pipe runs will sometimes go far toward paying for the compressor.

Where the piping system is extensive, an occasional check at night or on Sunday may detect important leaks. Introducing ammonia into the compressor intake will assist in locating leaky sections. If possible, compressed air should not be used for combustion of gas. If the entire supply for combustion is compressed air, the cost may equal that of the gas burned. Inspirating burners should be installed, using but a small jet of compressed air.

Determination of Change Gears

Many methods of finding gear ratios have been given in these pages, but here is another whose simplicity recommends it

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IN THE following method for the determination of change gears, the calculations involved are straightforward and simple. The principle involved is based on the fact that the ratio difference between successive pairs of gears approaches a minimum as the ratios approach unity. Therefore, in order to obtain the greatest accuracy, the ratio under consideration is multiplied by a fraction, such that the product approximates unity, whence gears may be selected from a table of ratios which approximate unity.

Let R = the ratio for which change gears are required

Let $\frac{C}{D}$ be a fraction such that $R\frac{C}{D}$ is approximately equal to unity

Then $R = R\frac{C}{D} \times \frac{D}{C}$

and if $\frac{A}{B} = R\frac{C}{D}$

Then $R = \frac{A}{B} \times \frac{D}{C}$

Where A, B, C, D are whole numbers, and for which change gears are available having these numbers of teeth.

The procedure, then, is as follows:

1. Multiply the required ratio by a fraction $\frac{C}{D}$, such that the product approximates unity.
2. From the tables select gears $\frac{A}{B}$ or $\frac{B}{A}$ nearest to the product so found.
3. The required change gears are $\frac{D}{C} \times \frac{A}{B}$ or $\frac{D}{C} \times \frac{B}{A}$

Consecutive Number Equivalents of Decimals from 0.9000 to 1.1111

A	B	A/B	B/A	A	B	A/B	B/A	A	B	A/B	B/A
120	119	1.0084	.9917	117	115	1.0174	.9829	67	65	1.0308	.9703
119	118	1.0085	.9916	58	57	1.0175	.9828	100	97	1.0309	.9700
118	117	1.0085	.9915	115	113	1.0177	.9826	33	32	1.0313	.9697
117	116	1.0086	.9915	57	56	1.0179	.9825	98	95	1.0316	.9694
116	115	1.0087	.9914	113	111	1.0180	.9823	65	63	1.0317	.9692
115	114	1.0088	.9913	56	55	1.0182	.9821	97	94	1.0319	.9691
114	113	1.0088	.9912	111	109	1.0183	.9820	32	31	1.0323	.9687
113	112	1.0089	.9912	55	54	1.0185	.9818	95	92	1.0326	.9684
112	111	1.0090	.9911	109	107	1.0187	.9817	63	61	1.0328	.9683
111	110	1.0091	.9910	54	53	1.0189	.9815	94	91	1.0330	.9681
110	109	1.0092	.9909	107	105	1.0190	.9813	31	30	1.0333	.9677
109	108	1.0093	.9908	53	52	1.0192	.9811	92	89	1.0337	.9674
108	107	1.0093	.9907	105	103	1.0194	.9810	61	59	1.0339	.9672
107	106	1.0094	.9907	52	51	1.0196	.9808	91	88	1.0341	.9670
106	105	1.0095	.9906	103	101	1.0198	.9806	30	29	1.0345	.9667
105	104	1.0096	.9905	51	50	1.0200	.9804	119	115	1.0348	.9664
104	103	1.0097	.9904	101	99	1.0202	.9802	89	86	1.0349	.9663
103	102	1.0098	.9903	50	49	1.0204	.9800	59	57	1.0351	.9661
102	101	1.0099	.9902	99	97	1.0206	.9798	88	85	1.0353	.9659
101	100	1.0100	.9901	49	48	1.0208	.9796	117	113	1.0354	.9658
100	99	1.0101	.9900	97	95	1.0211	.9794	29	28	1.0357	.9655
99	98	1.0102	.9899	48	47	1.0213	.9792	115	111	1.0360	.9652
98	97	1.0103	.9898	95	93	1.0215	.9789	86	83	1.0361	.9651
97	96	1.0104	.9897	47	46	1.0217	.9787	57	55	1.0364	.9649
96	95	1.0105	.9896	93	91	1.0220	.9785	85	82	1.0366	.9647
95	94	1.0106	.9895	46	45	1.0222	.9783	113	109	1.0367	.9646
94	93	1.0108	.9894	91	89	1.0225	.9780	28	27	1.0370	.9643
93	92	1.0109	.9892	45	44	1.0227	.9778	111	107	1.0374	.9640
92	91	1.0110	.9891	89	87	1.0230	.9775	83	80	1.0375	.9639
91	90	1.0111	.9890	44	43	1.0233	.9773	55	53	1.0377	.9636
90	89	1.0112	.9889	87	85	1.0235	.9770	82	79	1.0380	.9634
89	88	1.0114	.9888	43	42	1.0238	.9767	109	105	1.0381	.9633
88	87	1.0115	.9886	85	83	1.0241	.9765	27	26	1.0385	.9630
87	86	1.0116	.9885	42	41	1.0244	.9762	107	103	1.0388	.9626
86	85	1.0118	.9884	83	81	1.0247	.9759	80	77	1.0390	.9625
85	84	1.0119	.9882	41	40	1.0250	.9756	53	51	1.0392	.9623
84	83	1.0120	.9881	81	79	1.0253	.9753	79	76	1.0395	.9620
83	82	1.0122	.9880	40	39	1.0256	.9750	105	101	1.0396	.9619
82	81	1.0123	.9878	119	116	1.0259	.9748	26	25	1.0400	.9615
81	80	1.0125	.9877	79	77	1.0260	.9747	103	99	1.0404	.9612
80	79	1.0127	.9875	118	115	1.0261	.9746	77	74	1.0405	.9610
79	78	1.0128	.9873	39	38	1.0263	.9744	51	49	1.0408	.9608
78	77	1.0130	.9872	116	113	1.0265	.9741	76	73	1.0411	.9605
77	76	1.0132	.9870	77	75	1.0267	.9740	101	97	1.0412	.9604
76	75	1.0133	.9868	115	112	1.0268	.9739	25	24	1.0417	.9600
75	74	1.0135	.9867	38	37	1.0270	.9737	99	95	1.0421	.9596
74	73	1.0137	.9865	113	110	1.0273	.9735	74	71	1.0423	.9595
73	72	1.0139	.9863	75	73	1.0274	.9733	49	47	1.0426	.9592
72	71	1.0141	.9861	112	109	1.0275	.9732	73	70	1.0429	.9589
71	70	1.0143	.9859	37	36	1.0278	.9730	97	93	1.0430	.9588
70	69	1.0145	.9857	110	107	1.0280	.9727	24	23	1.0435	.9583
69	68	1.0147	.9855	73	71	1.0282	.9726	119	114	1.0439	.9580
68	67	1.0149	.9853	109	106	1.0283	.9725	95	91	1.0440	.9579
67	66	1.0152	.9851	36	35	1.0286	.9722	71	68	1.0441	.9577
66	65	1.0154	.9848	107	104	1.0288	.9720	118	113	1.0442	.9576
65	64	1.0156	.9846	71	69	1.0290	.9718	47	45	1.0444	.9574
64	63	1.0159	.9844	106	103	1.0291	.9717	117	112	1.0446	.9573
63	62	1.0161	.9841	35	34	1.0294	.9714	70	67	1.0448	.9571
62	61	1.0164	.9839	104	101	1.0297	.9712	93	89	1.0449	.9570
61	60	1.0167	.9836	69	67	1.0299	.9710	116	111	1.0450	.9569
60	59	1.0169	.9833	103	100	1.0300	.9709	23	22	1.0455	.9565
119	117	1.0171	.9832	34	33	1.0303	.9706	114	109	1.0459	.9561
59	58	1.0172	.9831	101	98	1.0306	.9703	91	87	1.0460	.9560

Consecutive Number Equivalents of Decimals from 0.9000 to 1.1111 (Continued)

A	B	A/B	B/A	A	B	A/B	B/A	A	B	A/B	B/A
68	65	1.0462	.9559	111	104	1.0673	.9369	86	79	1.0886	.9186
113	108	1.0463	.9558	95	89	1.0674	.9368	49	45	1.0888	.9184
45	43	1.0465	.9556	79	74	1.0676	.9367	110	101	1.0891	.9182
112	107	1.0467	.9554	63	59	1.0678	.9365	61	56	1.0893	.9180
67	64	1.0469	.9552	110	103	1.0680	.9364	73	67	1.0896	.9178
89	85	1.0471	.9551	47	44	1.0682	.9362	85	78	1.0897	.9176
111	106	1.0472	.9550	78	73	1.0685	.9359	97	89	1.0899	.9175
22	21	1.0476	.9545	109	102	1.0686	.9358	109	100	1.0900	.9174
109	104	1.0481	.9541	31	29	1.0690	.9355	12	11	1.0909	.9167
87	83	1.0482	.9540	108	101	1.0693	.9352	119	109	1.0917	.9160
65	62	1.0484	.9538	77	72	1.0694	.9351	107	98	1.0918	.9159
108	103	1.0485	.9537	46	43	1.0698	.9348	95	87	1.0920	.9158
43	41	1.0488	.9535	107	100	1.0700	.9346	83	76	1.0921	.9157
107	102	1.0490	.9533	61	57	1.0702	.9344	71	65	1.0923	.9155
64	61	1.0492	.9531	76	71	1.0704	.9342	59	54	1.0926	.9153
85	81	1.0494	.9529	91	85	1.0706	.9341	106	97	1.0928	.9151
106	101	1.0495	.9528	106	99	1.0707	.9340	47	43	1.0930	.9149
21	20	1.0500	.9524	15	14	1.0714	.9333	82	75	1.0933	.9146
104	99	1.0505	.9519	119	111	1.0721	.9328	117	107	1.0935	.9145
83	79	1.0506	.9518	104	97	1.0722	.9327	35	32	1.0938	.9143
62	59	1.0508	.9516	89	83	1.0723	.9326	93	85	1.0941	.9140
103	98	1.0510	.9515	74	69	1.0725	.9324	58	53	1.0943	.9138
41	39	1.0513	.9512	59	55	1.0727	.9322	81	74	1.0946	.9136
102	97	1.0515	.9510	103	96	1.0729	.9320	04	95	1.0947	.9135
61	58	1.0517	.9508	44	41	1.0732	.9318	123	21	1.0952	.9130
81	77	1.0519	.9506	117	109	1.0734	.9316	103	94	1.0957	.9126
101	96	1.0521	.9505	73	68	1.0735	.9315	80	73	1.0959	.9125
20	19	1.0526	.9500	102	95	1.0737	.9314	57	52	1.0962	.9123
119	113	1.0531	.9496	29	27	1.0741	.9310	91	83	1.0964	.9120
99	94	1.0532	.9495	101	94	1.0745	.9307	34	31	1.0968	.9118
79	75	1.0533	.9494	72	67	1.0746	.9306	113	103	1.0971	.9115
59	56	1.0536	.9492	115	107	1.0748	.9304	79	72	1.0972	.9114
98	93	1.0538	.9490	43	40	1.0750	.9302	45	41	1.0976	.9112
39	37	1.0541	.9487	100	93	1.0753	.9300	101	92	1.0978	.9109
97	92	1.0543	.9485	57	53	1.0755	.9298	56	51	1.0980	.9107
58	55	1.0545	.9483	71	66	1.0758	.9296	67	61	1.0984	.9104
77	73	1.0548	.9481	85	79	1.0759	.9294	78	71	1.0986	.9103
96	91	1.0549	.9479	99	92	1.0761	.9293	89	81	1.0988	.9101
115	109	1.0550	.9478	113	105	1.0762	.9292	100	91	1.0989	.9100
19	18	1.0556	.9474	14	13	1.0769	.9286	111	101	1.0990	.9099
113	107	1.0561	.9469	111	103	1.0777	.9279	11	10	1.1000	.9091
94	89	1.0562	.9468	97	90	1.0778	.9278	120	109	1.1009	.9083
75	71	1.0563	.9467	83	77	1.0779	.9277	109	99	1.1010	.9083
56	53	1.0566	.9464	69	64	1.0781	.9275	98	89	1.1011	.9082
93	88	1.0568	.9462	55	51	1.0784	.9273	87	79	1.1013	.9080
37	35	1.0571	.9459	96	89	1.0787	.9271	76	69	1.1014	.9079
92	87	1.0575	.9457	41	38	1.0789	.9268	65	59	1.1017	.9077
55	52	1.0577	.9455	109	101	1.0792	.9266	119	108	1.1019	.9076
73	69	1.0580	.9452	68	63	1.0794	.9265	54	49	1.1020	.9074
91	86	1.0581	.9451	95	88	1.0795	.9263	97	88	1.1023	.9072
109	103	1.0583	.9450	27	25	1.0800	.9259	43	39	1.1026	.9070
18	17	1.0588	.9444	94	87	1.0805	.9255	118	107	1.1028	.9068
107	101	1.0594	.9439	67	62	1.0806	.9254	75	68	1.1029	.9067
89	84	1.0595	.9438	107	99	1.0808	.9252	107	97	1.1031	.9065
71	67	1.0597	.9437	40	37	1.0811	.9250	32	29	1.1034	.9062
53	50	1.0600	.9434	93	86	1.0814	.9247	117	106	1.1038	.9060
88	83	1.0602	.9432	53	49	1.0816	.9245	85	77	1.1039	.9059
35	33	1.0606	.9429	119	110	1.0818	.9244	53	48	1.1042	.9057
87	82	1.0610	.9425	66	61	1.0820	.9242	74	67	1.1045	.9054
52	49	1.0612	.9423	79	73	1.0822	.9241	95	86	1.1047	.9053
69	65	1.0615	.9420	92	85	1.0824	.9239	116	105	1.1048	.9052
86	81	1.0617	.9419	105	97	1.0825	.9238	21	19	1.1053	.9048
103	97	1.0619	.9417	118	109	1.0826	.9237	115	104	1.1058	.9043
120	113	1.0619	.9417	13	12	1.0833	.9231	94	85	1.1059	.9043
17	16	1.0625	.9412	116	107	1.0841	.9224	73	66	1.1061	.9041
118	111	1.0631	.9407	103	95	1.0842	.9223	52	47	1.1064	.9038
101	95	1.0632	.9406	90	83	1.0843	.9222	83	75	1.1067	.9036
84	79	1.0633	.9405	77	71	1.0845	.9221	114	103	1.1068	.9035
67	63	1.0635	.9403	64	59	1.0847	.9219	31	28	1.1071	.9032
117	110	1.0636	.9402	115	106	1.0849	.9217	103	93	1.1075	.9029
50	47	1.0638	.9400	51	47	1.0851	.9216	72	65	1.1077	.9028
83	78	1.0641	.9398	89	82	1.0854	.9213	113	102	1.1078	.9027
116	109	1.0642	.9397	38	35	1.0857	.9211	41	37	1.1081	.9024
33	31	1.0645	.9394	101	93	1.0860	.9208	92	83	1.1084	.9022
115	108	1.0648	.9391	63	58	1.0862	.9206	51	46	1.1087	.9020
82	77	1.0649	.9390	88	81	1.0864	.9205	112	101	1.1089	.9018
49	46	1.0652	.9388	113	104	1.0865	.9204	61	55	1.1091	.9016
114	107	1.0654	.9386	25	23	1.0870	.9200	71	64	1.1094	.9014
65	61	1.0656	.9385	112	103	1.0874	.9196	81	73	1.1096	.9012
81	76	1.0658	.9383	87	80	1.0875	.9195	91	82	1.1098	.9011
97	91	1.0659	.9381	62	57	1.0877	.9194	101	91	1.1099	.9010
113	106	1.0660	.9381	99	91	1.0880	.9192	111	100	1.1100	.9009
16	15	1.0667	.9375	37	34	1.0882	.9189	10	9	1.1111	.9000

The various manufacturers of machine tools supply different sets of change gears, and the tables are therefore made to cover combinations of gears having teeth from 120 down, and whose ratios are between 0.9000 and 1.1111.

The following three examples will illustrate the simplicity of the method:

Example I. Required ratio = 3.159628

Let $\frac{C}{D} = \frac{30}{90}$

Then $R\frac{C}{D} = 3.159628 \times \frac{30}{90} = 1.0532 = \frac{A}{B}$

From the tables, $\frac{A}{B} = \frac{99}{94}$

and the change gears are $\frac{90}{30} \times \frac{99}{94}$ or $\frac{45}{30} \times \frac{99}{47}$

giving a ratio of 3.159575, the error being 1 in 60,000.

Example II. Required ratio = 0.548891

Let $\frac{C}{D} = \frac{100}{56}$

Then $R\frac{C}{D} = 0.548891 \times \frac{100}{56} = 0.9802 = \frac{B}{A}$

From the tables, $\frac{B}{A} = \frac{99}{101}$

and the change gears are $\frac{56}{100} \times \frac{99}{101}$

giving a ratio of 0.548911, the error being 1 in 27,000.

Example III. Required ratio = 0.054196

Let $\frac{C}{D} = \frac{100}{6}$

Then $R\frac{C}{D} = 0.054196 \times \frac{100}{6} = 0.9033 = \frac{B}{A}$

From the tables, $\frac{B}{A} = \frac{28}{31}$

and the change gears are $\frac{6}{100} \times \frac{28}{31}$

As no 6-tooth gear will be available, the ratio must be rearranged, as follows:

$$\frac{6}{100} \times \frac{28}{31} = \frac{6}{100} \times \frac{4 \times 7}{31} \times \frac{3}{3} = \frac{24}{100} \times \frac{21}{93}$$

giving a ratio of 0.054194, the error being 1 in 27,000.

Arc Welded Machine Parts of Huge Proportions

D. B. CHARTERS
Manufacturing Engineer, Westinghouse Electric & Manufacturing Company

PARTS for the 750,000-lb. press built by the E. W. Bliss Company are of arc-welded construction. The finished machine is 29 ft. high, over 28 ft. long and more than 12 ft. wide.

The press is guaranteed to form two automobile side rails of $\frac{5}{32}$-in. stock 16½ ft. long at one stroke with the web flat within 0.005 in. and the flanges at right angles to the web. The parts of each unit are so placed that the major portion of the stresses are absorbed without unduly stressing the welds. To obtain maximum strength all welds subject to heavy stress were made with coated rod.

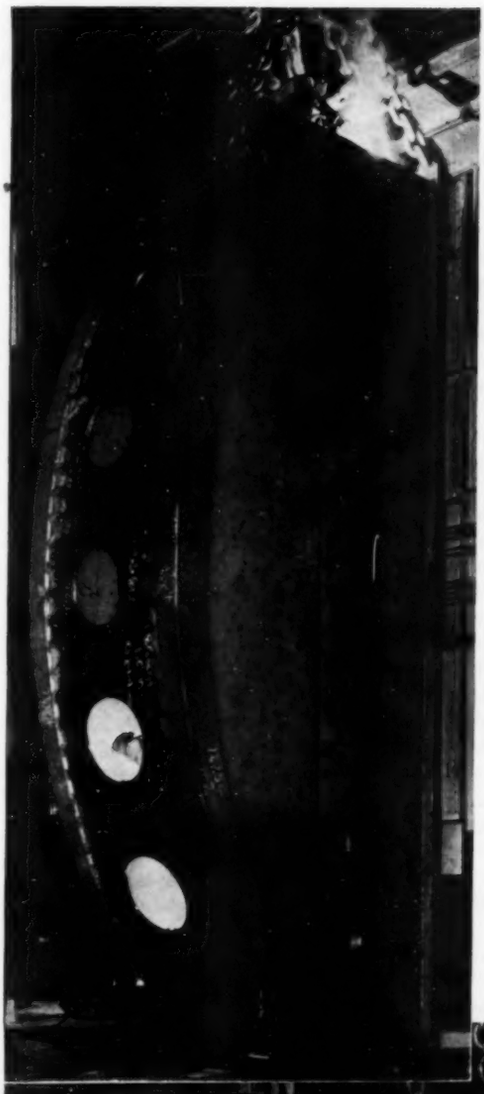
Heavy fillet welds made with coated rod require positioning of the part in order to obtain speed in welding. Because of the size of these parts butt welds were used whenever possible so that welding could be done with the work in a horizontal position. For butt welds up to 1 in. there is little to choose between a burned and a machined "preparation" the additional cost of the machined preparation being offset by the speed obtained in welding because a larger wire can be used from the start.

On welds larger than 1 in. surfaces prepared by machining are preferable because of the reduced area of the weld.

The writer wishes to acknowledge the cooperation of F. J. Rode, chief engineer and works manager, E. W. Bliss Company, in supplying information regarding the press.

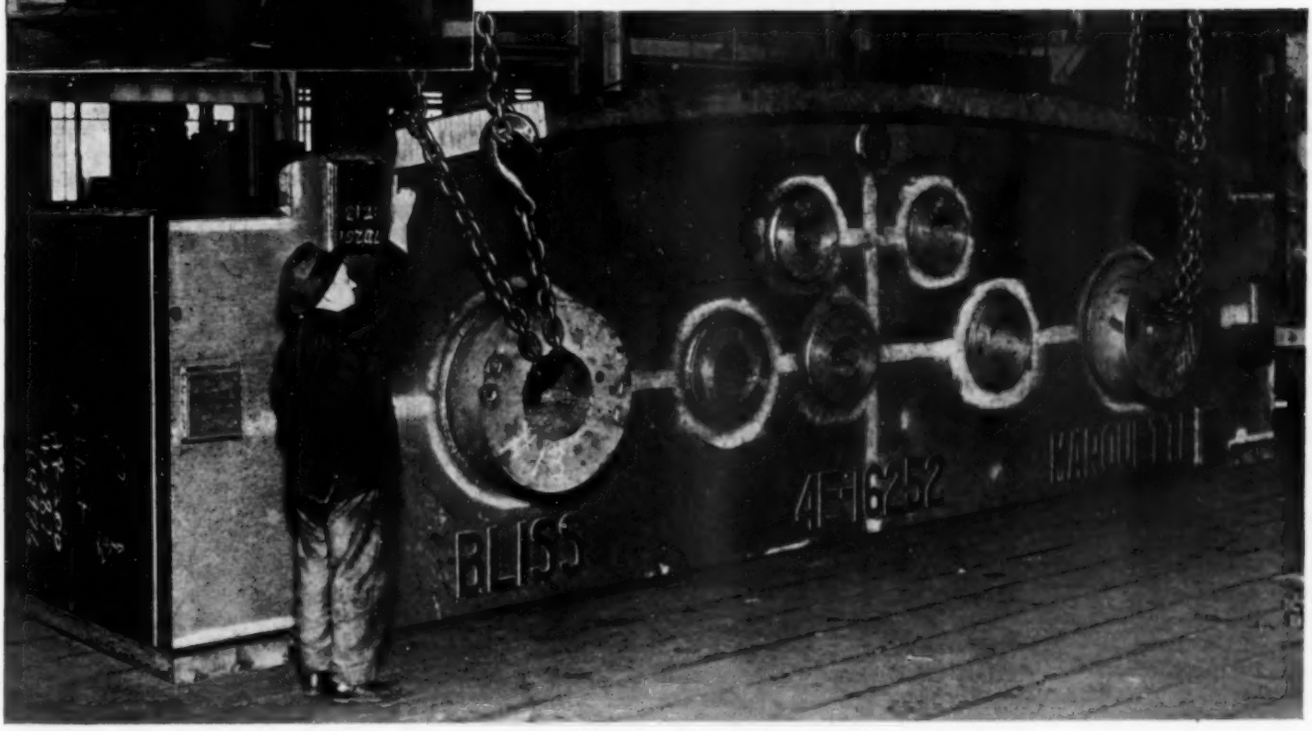
Upper right — With a weight of 157,000 lb., the bed of the press is the largest single unit. The side plates are 5 in. thick and the curved rib attached to the bottom of the plate is 9 x 12 in. in cross-section. One weld preparation was machined on this bar before bending and the other was burned on the curved portion of the side plate. This welding was done before assembly as was the attachment of the brackets and parts on the inner side of the bed plates

Lower right—In order to avoid deflection the bed was designed for a load of 2,500 tons although the working capacity of the press is 1,800 tons plus a cushion load of 300 tons. The working area of this member is 21 ft. long between housings, 5 ft. 8 in. from front to back. Depth of the bed is 10 ft. The bed was positioned as shown in the illustration for the fillet welds used in the spacing plates between the sides. This view gives an excellent idea of the box construction



Left—For welding the ends the bed is positioned as shown. The man at the top is welding the outside butt seam while another welder is finishing the inside weld at the lower end. The man who can be seen through the second manhole is welding the bottom of the spacers to the bottom stiffening plate. The structure was strain relieved

Below—Hanging from the crane is one of the uprights with the box-section flywheel bracket shown in the foreground



Here the crown of the press is shown in the process of assembly. Attaching the bosses and lettering was done on the individual side plates before fabrication. The bosses are of cast steel turned to a light press fit in the side plates; the plates were bored and machined for the weld. The heavy loads are taken in compression through the members and not through the welds

Lubrication for Anti-Friction Bearings

O. L. MAAG

Lubricating Engineer,
The Timken Roller Bearing Company

LUBRICANTS for industrial anti-friction bearing applications include the following types: lime soap, soda soap, aluminum stearate, lead base, and mixed base greases, together with oils of various degrees of refinement ranging from the light-bodied non-viscous oils to the heavy cylinder stocks. These lubricants take care of practically all types of bearings. There are, however, a number of applications which are heavily loaded or where the speeds are such that a new kind of lubricant, such as the extreme pressure type which has come to the fore during the last few years, should be used. These "alloyed lubricants" serve a definite type of service in the lubrication field just as alloy steels do in modern industry.

Extreme pressure properties may be imparted to either oils or greases, and there are on the market today extreme pressure greases of practically all types and extreme pressure oils covering the range of viscosities used for lubricating various bearings in service.

Different types of greases are used in applications where such lubricants are most suitable. Lime soap greases, which are usually the cheapest ones to compound, have the widest use. These products, as well as those compounded with aluminum stearate, are used in units where water conditions might be encountered. They do not, however, have as high melting points as soda soap greases, and their use is usually confined to the lower temperature operating conditions.

Soap Deposits

When subjected to high operating temperatures, and as a rule with higher operating speeds, a soda soap lubricant is usually preferable. Many greases have the disadvantage that, with the higher operating temperatures encountered on higher speed units, there is a marked tendency for the lubricants to become thin. The centrifugal force created by the higher speed of the bearings has a tendency to throw out the oil from such lubricants. After cooling, a layer of heavy soap is found in the bottom of the bearing housings, the oil often having drained out through the bearing closures.

Soda soap greases as a rule will stand up better under high temperatures and high speed conditions than lime soap products, although it must be kept in mind that there is much in the art of compounding these lubricants to give them the desired properties in regard to stability in storage and in service. Aluminum stearate greases will usually return to their original consistency even if they are heated considerably above their melting point. This property cannot as a rule be imparted to lime or soda soap greases.

Aeroplane Rocker Arm Greases

Apparently for this reason aluminum stearate greases are used extensively for aeroplane rocker arm units. It has been the experience of the Timken Company that such greases are superior to soda soap products for this service. The usual specification calls for a grease compounded from a well refined cylinder oil of 150 seconds to 200 seconds viscosity at 210 F. and aluminum stearate. Cylinder stocks of 600 to 800 seconds viscosity at 210 F. plus aluminum stearate should be given more consideration for use in grease lubricated rocker arms.

In order to obtain better conditions for rocker arm bearings, a circulating oil system would undoubtedly prove highly beneficial. By circulating cooled crank case oil very much lower bearing temperatures would result, and with lower temperatures less oxidation and breaking down of the oil would occur. It is realized that the aeroplane builder will hesitate to increase the weight of his engines. However, since he is today building engines of greater horsepower, thus creating more heat, it is possible that he will be required to dissipate some of the additional heat by circulating cooled oil.

Most greases of tomorrow will undoubtedly be of the extreme pressure type. Many steel mill applications which are now on anti-friction bearings will operate successfully with the average greases that do not contain extreme pressure properties. However, there are a number of units on which the extreme pressure greases are necessary, due to the higher speeds and increased loads which are encountered today.

In some of the applications where past experience indicates that extreme pressure greases are not necessary, they have been used without any harmful effects. Therefore, in order to be on the safe side the Timken Company has made it a practice to recommend extreme pressure greases entirely for this service. No one knows when some operating condition is going to cause overloading, and possibly the ruin of a bearing; hence, the company feels it is good practice to recommend this additional protection for their bearings, and believes that this applies with equal force to all types of bearings.

The grease which is used on roll necks of steel mill applications should usually be water repellent. Good success has been reported with lime-lead soap-sulfur products, as well as with lime soap sulfurized base and lime soap-sulfur-chloride base.

Many greases used for roll neck plain bearings are compounded from heavy black oils, soaps, and various percentages of inorganic fillers, such as graphite, lime, talc, mica and zinc oxide. The inorganic fillers serve to polish the bearings, giving in a short time well run-in bearing surfaces. However, the disadvantage of these products is that they continue to wear away the bearings, with the result that replacements are usually quite high. There are numerous instances where better bearing life was obtained when extreme pressure greases free from fillers were used.

Steel Mill Greases

The Timken Company has specified that steel mill greases for use with their bearings should carry a minimum load of 33 lbs. on the Timken lubricant tester, and be of proper consistency for local operating conditions. Three consistencies are usually required. Based on practical experience, the company feels that a lubricant carrying a 33-lb. load will give no trouble in the field.

Often gears and anti-friction bearings

Abstracted from a paper presented before the National Association of Lubricating Grease Manufacturers at Chicago, October 17, 1934.

are lubricated with the same lubricant. In this case, the mineral oil which is satisfactory for the gears is usually entirely satisfactory for the anti-friction bearings. In quite a few cases, however, in order to take care of the gear units, it has been found necessary for good operation to use an extreme pressure lubricant of approximately 90 to 150 seconds viscosity at 210 F. These lubricants should carry a minimum load of 33 lbs. on the Timken lubricant tester. The types of extreme pressure lubricants with which the Timken Company has had success on these units are those having a lead soap sulfur base, a chlorinated sulfur base, and the straight chlorinated base products.

For table rolls, etc., encountered in mills and factories, the type of lubricant is largely dependent on the design of the closures. If the closures are tight, fluid oils are entirely satisfactory. As the frictional loads are lower with oil lubrication when this type of lubricant can be used the company prefers to recommend it.

A number of applications, however, are so designed as to make grease lubricants preferable. In such cases, under normal operating conditions, the usual lime soap grease is satisfactory. In cases where operating temperatures are somewhat high, a change to a soda soap grease which will take care of the additional temperatures encountered is advisable.

High Speed Applications

For high speed applications, such as electric motors and high speed spindles, designed for grease lubrication, best success has been had with soda soap products. This type of grease does not separate at the usual operating speeds and temperatures as do the lime soap greases, resulting in better lubrication and much longer bearing life.

The type of soda soap grease which has given best service with Timken bearings has been the short fiber, smooth texture product. These greases do not have the same tendency to channel as do the somewhat stringy fibrous products, and their lubricating action seems to be similar to that of the lime soap greases. The channeling and poor lubricating ability of the stringy, fibrous greases seem to be more pronounced under low temperature operating conditions. The smooth textured soda soap greases which have given best results for average service have been those compounded with refined oils of from 200 to 600 seconds viscosity at 100 F.

Some of these soda products have a tendency to become quite stringy on being worked, while others become more smooth. In our experience those with a tendency to become smoother give best results in service. We cannot, at this time, enlighten you as to the cause of this phenomenon. Perhaps some manufacturer has the answer and will be willing to tell how to overcome it. Recently, two grades of a grease made by a certain company were tested in the Timken laboratory. One had a tendency to string out on working while the other became more smooth. Possibly a slight variation in the acidity or alkalinity may be the answer.

E-P Running-In Oils

Industrial machinery frequently includes high speed units in which oil lubrication is desirable. Usually these units are comparatively lightly loaded. However, high speeds often bring about conditions where overheating is encountered, at least until after the bearings are well run in. In such units well refined mineral oils are usually satisfactory. A number of cases, however, have been encountered where on new installations of bearings there was apparently an overloaded condition. In such cases Timken practice has been to go to the use of an extreme pressure oil for a running-in lubricant, merely adding the extreme pressure base oil to the mineral oil. Usually the one charge of extreme pressure oil is sufficient to last the machine for the run-in period, after which straight mineral oils are entirely satisfactory.

Sight feed, constant level and wick feed oilers are ordinarily used on industrial equipment, the latter two usually being the most economical. In order to have a product that is economical for use with sight feed oilers, oils compounded with around ¼ to ½ per cent of soaps are used. Such compounded oils adhere better to bearing surfaces and also feed more slowly.

There are a number of applications where circulating oil systems are desired, such as on gear drives, and the bearings connected with them in mills or other industrial units. The following advantages may be attributed to circulating oil systems:

1. Ample lubrication.
2. The circulation of the oil through the bearings has a cleansing action, washing out any foreign matter.
3. There is no churning of the lubricant, hence, with the minimum amount of lubricant present, lower operating temperatures are generally secured.
4. With a circulating system it is possible to provide for settling and filtering the lubricant. In case the lubricant has a tendency to become warm, it is possible to cool it separately, thus keeping the system supplied at all times with clean, cool lubricant.
5. The cooler operating conditions will reduce the oxidation or breaking down of the lubricant and thus increase its life.

For example, a circulating oil system is desirable for lubricating the dryer rolls of paper mills. Since the dryers are heated with steam under pressure, the bearings will always be quite warm, and as it is almost impossible to keep paper dust and condensed steam from getting into the bearing housings, the advantages of a circulating system are apparent. Due to the high temperatures encountered, a well refined cylinder oil, similar to SAE 70 motor oil, has proven quite satisfactory.

There are, of course, instances where it is not feasible to install a circulating oil system. In such cases a fixed level oil bath should be maintained and provision made for changing the lubricant at frequent intervals.

The Jordan engines in paper mills may advantageously be placed on the same system with the dryer rolls. Gear reduction units, and their bearings, for the drives of paper mills are usually lubricated by well refined cylinder oils, both bearings and gears being supplied with the same lubricant. In cases where these applications are heavily loaded the use of extreme pressure lubricants such as SAE 90 E.P. and SAE 110 E.P., has proved satisfactory.

Railway Bearings

During the last several years the use of industrial bearings on railroad rolling stock has come to the fore, and it seems evident that their use will steadily increase in this type of equipment in the future. For that reason grease manufacturers should know which types of lubricant have proven most satisfactory for this type of bearing.

The Timken Company has experimented with greases of various types, and with oils of various viscosities. To date, however, the best all around service has been obtained by the use of fairly well refined cylinder stock oils of approximately 125 seconds viscosity at 210 F. This type of oil has the advantage of having more body or film strength than the usual car oils which are in general use on railroad rolling stock. It also has sufficient body at operating temperatures to avoid difficulty with leakage or loss from the present bearing housings, and partly for this reason operating costs are likely to show up better with this type oil.

The Timken Roller Bearing Company is, however, inclined to feel that in order to meet extreme weather conditions better the next move will be toward a lower viscosity oil, and one containing extreme pressure properties.

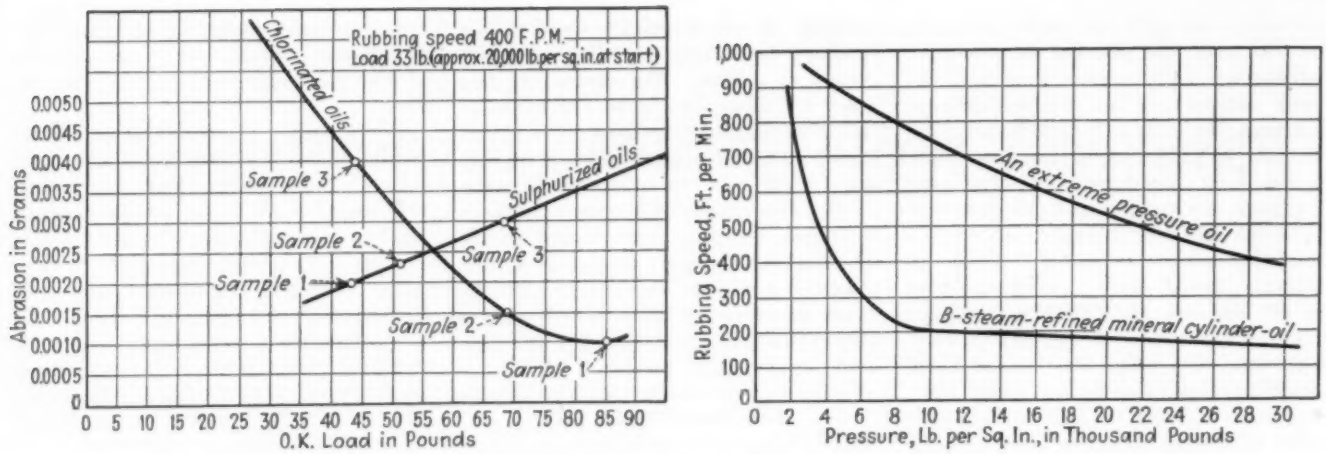

Rubbing speed 400 F.P.M.
Load 33 lb. (approx. 20,000 lb. per sq. in. at start)
Chlorinated oils
Sulphurized oils
Sample 1
Sample 2
Sample 3
Abrasion in Grams
O.K. Load in Pounds
An extreme pressure oil
B-steam-refined mineral cylinder-oil
Rubbing Speed, Ft. per Min.
Pressure, Lb. per Sq. In., in Thousand Pounds

Fig. 1—At the left is charted the relation of wear and pressure for sulphurized and chlorinated oils, and at the right is shown the relation of rubbing speed to pressure before scuffing starts for an extreme-pressure oil and a straight cylinder oil

By the use of such an oil, lower frictional results will naturally be obtained.

Testing Apparatus

In order to measure in the laboratory the film strengths of various types of lubricant which might be encountered, the Timken Roller Bearing Company developed the Timken lubricant and wear testing machine, which has been quite helpful in obtaining data to help solve problems with which the company has been confronted. Straight mineral oils increase in film strength with increase in viscosity, and this machine demonstrates that fact. When dealing with extreme pressure lubricants, however, viscosity of the oil is of secondary consideration.

The type of element used to increase film strengths shows up prominently as illustrated by Fig. 1.

It will be noted that the curve shows that with an increase in sulphur content of the oil the film strength increases to a certain point. Apparently the maximum benefit is obtained with approximately 3 per cent sulphur. These lubricants were made by increasing the concentration of a certain sulphurized base oil. As the sulphur content of this oil was increased, the abrasive or wear producing properties were also increased. In contrast to this, when using a chlorinated type product it will be seen that with the high concentration of the chlorinated base oil a high film strength was developed, with lower wear or abrasive properties. By decreasing the percentage of base in this type of lubricant a decrease in the film strength and an increase in the abrasive properties was obtained.

Table I illustrates clearly the results obtained by the use of the two elements ordinarily used to impart extreme pressure properties to lubricants.

TABLE I

Lubricant	Specimen	OK Load	Wear 6 hrs. with 33-lb. lever load
Chlorinated oils..	#1	100 lbs. plus	0.0035 grams
	2	95 "	0.0030 "
	3	100 "	0.0045 "
	4	95 "	0.0020 "
	5	59 "	0.0050 "
Sulphurized fatty oils.....	#1	43 "	0.0070 "
	2	43 "	0.0150 "
	3	33 "	0.0050 "
	4	33 "	0.0055 "
	5	43 "	0.0080 "
	6	43 "	0.0075 "

Lead, sulphur and chlorine have been the substances largely used thus far in compounding extreme pressure lubricants. Due to the difference in properties of these substances, it is likely that lubricants containing various combinations of these substances will prove best for different services. The Timken Company is inclined to feel that more attention should be directed toward the use of definite chemical compounds, such as hexachlorethane, chlorinated retene, etc., instead of trying to sulphurize and chlorinate complex fats whose resultant product is variable and unknown.

A Problem in Dimensions Discussion

L. KASPER

Referring to the suggestion of Paul C. Bruhl in an article under the title given above (*AM*—Vol. 78, page 681) regarding my article under the same title (page 516), permit me to say that Mr. Bruhl has overlooked the fact that it is impossible to determine just where to start the angular cut for the bore until the angular groove has been cut; otherwise there would be no problem.

Referring to the illustration in my article assuming bore *A* and counterbore *C* to have been machined to correct dimensions, there is nothing to indicate the correct position for starting the angular cut, which is to be tangent to the radius formed on the lower edge of dimension *E*, as this cut could be started at a number of different points without changing the dimension *A*. But incorrect positioning of this cut would fail to meet the requirements of tangency to the radius at the larger end of the bore. Therefore the method suggested by Mr. Bruhl would not serve the purpose.

Shaft Burnishing for Wear Resistance—Discussion

FRANK C. HUDSON

John E. Hyler (*AM*—Vol. 78, page 538) points to railway axles as an excellent example of the value of burnishing as a means of increasing the wear life. This is a disputed point with those who have abandoned burnishing for grinding. Both in England and in this country users of ground axle bearings report increased mileage up to 25 per cent.

One of the objections to burnishing is tentatively admitted by Mr. Hyler when he speaks of the need of a standard burnishing lathe. I have never seen one in use in any railroad shop. The usual method of using a single roller is hard on the axle lathe, and I am confident that no roller can give as round an axle as grinding. The surface given by grinding will, I believe, outwear any rolled surface, regardless of the hardness that may or may not be added by rolling. The modern axle of alloy steel is quite different from the old ones of low carbon steel.

EDITORIALS

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K. H. CONDIT F. H. COLVIN
EDITORS

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COULD YOU STAND PROSPERITY?

AT FIRST glance the question "Could you stand prosperity?" sounds like the ultimate in absurdity, but just take a second look at it and then look at your inventory, your equipment, and your personnel. Most of us feel devoutly that we could stand a whole lot of prosperity, and right now. Figuratively speaking we could, but as a practical matter prosperity that came too fast might be as devastating as the drops of the depression.

In the first place is there any sense in the question? Is there a chance for an immediate appreciable improvement in business in the metal-working field?

Some people don't think so, but against them we can set up the electrical manufacturing industry whose recent convention was charged with optimism. And the manufacturers of business machines, who have been running extra shifts for months. International Business Machines reports earnings of more than seven dollars a share in the first nine months of 1935. As a whole the automobile builders have done well this year, and most of them are planning for larger output next year.

These examples are enough to prove that the conviction expressed by a leading machine tool builder that at least a mild boom is imminent is not so foolish as it sounds. His other conviction—that the machinery industry, and particularly the machine tool branch of that industry is not in shape to meet sharply increased demand—is borne out by every bit of evidence we can find.

Inventories, generally, are low—some of them non-existent. A dealer told us last week that he didn't dare take a customer to the shop of one of his manufacturers because there was nothing to show. Some lucky orders had cleaned out this manufacturer's stock and he had made no effort to replace.

Equipment cannot be adequate, if we may judge from the practically negligible amount of replacement that has taken place in five years. The last *American Machinist* survey placed obsolescence at forty-eight per cent. The next survey may well show it at sixty.

Personnel is a real problem in any plant that demands skill. Even last March, when activity was only moderately increased, found employment managers scouring the surrounding towns for toolmakers and machinists to operate certain types of machines. Limits of accuracy are far closer now than they were even five years ago, and the man who has lost his "touch" cannot regain it at once after a long lay off—perhaps never. Yet the company that has recognized this danger and has prepared for it is the rare exception. Such a one is the Norton Company whose special apprentice plan was described in the last number.

NOBODY can guarantee that business is going to get better at once, but there is enough reason to believe that it will to make it vitally necessary to be prepared. You may want prosperity very much indeed but you should be prepared for it when it comes. Begin to get ready now.

Inflation

ADMINISTRATION spokesmen maintain that its record is a guarantee against inflation of the currency. Assuming that the hope and intention of the President is to avoid the kind of inflation that wrecked several European currencies—and almost anyone will give him the benefit of the doubt on that—his record is not exactly what one usually regards as a guarantee. His deficit this year will probably reach $2,000,000,000, and the national debt is at a record high. The vital objective in the fight against inflation is a balanced federal budget. It is attainable if the Administration will stop pointing to its record and the opposition will stop crying wolf, and both together will try to secure the sort of control of expenditure that brings a budget into balance.

A Hopeful Sign

THE WORLD moves on. A railroad shop has installed a completely mechanized brass foundry which includes sand conditioning and handling, rocking electric furnaces with monorail systems for charging and pouring, permanent molding machines and all the rest. This installation is especially interesting because the foundry very often lags behind the rest of the plant.

Whoever the sales engineer responsible for this installation was, he deserves a medal. Nor should we forget the plant executives who saw the advantages and extracted the appropriation from the man with the check book. Fully mechanized machine departments for railways would probably seldom be warranted. But there is hardly a railroad shop which does not need better machine equipment. Builders of machines that will save money in railway shops should find this foundry installation encouraging.

.CHIPS.

Washington—President Roosevelt makes reassuring speech to bankers' convention and gets pledge of cooperation from their officers . . . Eastman proposes that railroads pool freight cars to save $75,000,000 annually spent in hauling empties . . . Eckener and Litchfield testify to soundness of transatlantic dirigible service, interest Roosevelt in possibilities . . . PWA asks for $12,000,000,000 for five-year public works plan, $7,000,000,000 for federal construction, balance to be matched dollar for dollar by state and municipal authorities . . . Roosevelt postpones federal pay cut restoration until July 1, 1935 . . . Appoints Richberg director of new Emergency Council including Cabinet officers and heads of major permanent and relief agencies . . . Navy Department will ask Congress for 42 ships regardless of outcome of London conference.

Foreign—England joins U. S. in protest against Manchukuoan oil monopoly . . . France prepares to follow Italy's lead and build 30,000-ton battle cruisers to offset 35,000-ton battleships . . . Japan's pressure for naval equality, believed to have German support, unites British and U. S. representatives in resistance . . . Soviets execute eight accused of grain stealing . . . British mission wins $40,000,000 in orders from Manchukuo . . . Likelihood of British arms inquiry remote for fear of muckraking disclosures . . . French army commanders prepare plans for action if Germany tries Saar "putsch."

Finance—Bankers urge balanced budget "at earliest possible date" . . . American Legion votes 987-183 for immediate bonus payment . . . International Business Machines earns $7.18 per share in first nine months . . . Plans completed to give small depositors in Detroit's First National Bank $60,000,000 as large depositors agree to stand aside . . . Stock Exchange Commission advisory committee recommends changes to simplify regulations . . . Dull business on the Stock Exchange forces many mergers and dissolutions of brokerage firms . . . Investment bankers appoint liaison committee to work with Washington for recovery . . . Controller of the Currency authorizes banks to exceed old legal limits in extending credit . . . Deposits in Federal Reserve member banks up $4,000,000,000 since bank holiday.

Industry—Westinghouse reports booking of million-dollar transformer order, largest in five years . . . Whiteside warns industry to offer suggestions for code changes before Congress meets, says government is withdrawing where possible . . . District of Columbia supreme court holds railway pension law unconstitutional . . . Silk dyers strike and textile labor leaders threaten further trouble . . . Automobile Code renewed . . . Mesta Machine gets order for cold rolling mill, 250,000 tons annual capacity, from Youngstown Sheet & Tube . . . A. & P. shuts down several hundred stores in Cleveland to avoid violence as unions demand closed shop . . . U. S. District Court judge in Alabama holds NIRA and lumber code unconstitutional, decision may be appealed to Supreme Court in 30 days . . . Hupp closes Cleveland body plant and will buy bodies from Hayes Body at saving of $60 plus freight.

Indicators—Steel production improves a point or so . . . Electric power output up over last week and 1933 week . . . Carloadings up . . . *Business Week's* index unchanged at 57.6.

Falk Corporation Is Host To Gear Manufacturers

At the 17th semi-annual meeting of the American Gear Manufacturers Association, held at the New Pfister Hotel, in Milwaukee, October 22-23, the members in attendance spent an afternoon inspecting the plant of the Falk Corporation. The visitors were particularly impressed with this concern's equipment for the making of large gear drives for marine and steel mill service. Carl S. Falk was present at the opening session and introduced Whitney H. Eastman, president of the Milwaukee Association of Commerce, who stated his belief that business recovery is moving forward.

H. H. Kerr, president, Boston Gear Works, chairman of the Association code authority urged support of the Durable Goods Industries Committee. L. R. Botsai, sales manager of the R. D. Nuttall division, Westinghouse Electric & Manufacturing Co., was appointed as Association delegate to the council of the Durable Goods Industries Committee with John H. Flagg, of the Watson Flagg Machine Co., as alternate.

Among the papers presented before the meeting were "Helical Gears in Retrospect and in Prospect," by P. C. Day of the Falk Corporation; "The Advantages of Sykes Herringbone Gears," by W. E. Sykes, Farrell-Birmingham Co.; "The Fallacy of Price Cutting as a Basis of Getting Sales," by Paul Christensen, Cincinnati Gear Co.; "Good Steel Foundry Practice in Gear Manufacture," by Arthur Simonson, vice-president of the Falk Corporation; and "Welded Steel Construction," by Thomas Holloway, engineer, United Engineering & Foundry Co.

In a discussion of British standards, helical and spur gear practice was presented by Professor F. A. Mickle, University of Michigan. An excellent discussion entitled, "Whither Bound?" was given by E. S. Sawtelle, manager, Tool Steel Gear & Pinion Co., in which he analyzed the various remedies that have been tried to effect economic recovery.

Eighteen companies were elected to membership at this meeting. About 100 members and visitors attended the sessions which were presided over by President John Christensen, of the Cincinnati Gear Works. Among the committee reports of note was that by M. T. Schumb, Boston Gear Works, who told of plans for gathering material for the A.G.M.A. Gear Book and publishing it in handbook form. Douglas B. Hamilton, Fellows Gear Shaper Co., presented the report of the nomenclature committee indicating that revision was nearing completion.

Donald Richberg to Address New England Conference

Donald R. Richberg, recently appointed to a key position in the merging of the administration's advisory bodies, is to address the tenth New England Conference to be held at the Statler Hotel, Boston, November 22-23. An opportunity will be afforded at that time for New England business men to set forth their positions in relation to the New Deal before important representatives of the federal government. According to an announcement made by Dudley Harmon, executive vice-president of the Council, the six New England Governors will address the opening session of the Conference.

Metal-Working Code Hearings Scheduled

Date	Place	Deputy Administrator	Association
Nov. 7	Commerce Bldg.	B. S. King	Institute of Boiler and Radiator Manufacturers
Nov. 13	Carlton Hotel	N. W. Foster	National Printing Equipment Association
Nov. 14	Washington Hotel	N. W. Foster	Road Machinery Manufacturers Association
Nov. 21	Commerce Bldg.	B. S. King	National Electrical Manufacturers (Refrigerating Machinery Division)

***Cincinnati Old Timers Are Honored*—At a special dinner at the Hotel Alms on October 25, employees of the Cincinnati Milling Machine Co. with over 25 years of service were given a special celebration. Frederick V. Geier, president of the company, thanked the group for the lessons they have taught the younger men of the organization and for their cooperation in carrying on the 50th anniversary celebration just concluded. The group pictured above includes executives, department heads, the employees service committee, foremen and the "Old Timers." Edward Sand, who has served the company for more than 50 years, was presented with a gold watch by Mr. Geier.**

FIRST ROW: N. Ashby, R. Schmidt, F. Reising, J. Veit, A. Fath, W. Meyer, E. Sands, E. Eck, H. Rose, H. Meyer, C. Rettig, L. Holmeyer, H. Gersman, B. Cunningham, J. Mann.
SECOND ROW: J. Bergin, J. Zumwalde, W. Enix, W. Peaslee, E. Klute, S. Einstein, L. Winstel, G. Niemeier, W. Geier, J. Habig, H. Aschemoor, W. Herrle, W. Egbert, W. Salathe, A. Fox, T. Lindeman, J. Vivier, M. J. Eberhardt, W. Tangeman, M. Eberhardt, O. Rasch, H. Williams, G. Schiele, F. V. Geier, P. O. Geier.
THIRD ROW: Dr. O. P. Geier, E. Pandorf, H. Hendricks, C. Gatch, C. Reitch, E. Henderson, G. Kuehter, T. Umbach, H. Krueger, C. Hohe, F. Lammers.

Motor Companies Speed Plans For 1935 Models

DETROIT—Factory sales of cars and trucks for the first nine months of this year totalled 2,493,277 as compared with 1,985,981 for the entire year of 1933 and 1,431,494 for 1932. September factory sales were 174,451, a decrease of over 28 per cent from August. A decrease of 5.5 per cent in the value of retail sales of new passenger cars from August to September is reported by the Department of Commerce; retail financing decreased 17 per cent for the same period. September sales will be close to 190,000 units with October estimated at 160,000.

While retail sales are registering an orderly decline, production has been curtailed to a greater extent resulting in a reduction of stocks; one volume company reports a decrease of 30,000 in a two-month period. November will register a still further decline in production of 1934 models and at the same time will witness the announcement of some 1935 models.

Tool and die shops are reported busy with a shortage of workers in some precision operations. Labor troubles are non-existent at present and not anticipated which will make possible the introduction of new models in accordance with carefully devised merchandising plans without the interruptions experienced last year. Dissatisfaction of the tool and die makers with the handling of the strike last fall and the extensive program of cooperation with tool and die makers conducted by shop owners during the past year accounts for the difference.

From present indications most manufacturers will make corrections in body lines which in some cases are expected to be extensive and with the LaSalle type of streamlining in especial favor. It is reported that, while the Chrysler Airflow will be continued without substantial change, conventional models will be added to the De Soto line to accommodate those customers who failed to accept the new lines of the present model. It is to be noted that the airflow lines ran counter to the increase in sales volume this year over last.

A survey conducted by one company of 35,000 sales handled through finance companies indicates that the average income of these car buyers was a little over $200 per month. With food, clothing and rent subtracted, a monthly figure of $75.00 was left to cover other expenditures, including the purchase of a car. A factual basis is thus indicated for the popularity of the small car and accounts for the eagerness of manufacturers to reach this income group.

Ford's announcement of his 1935 "million or better" car schedule reflects the optimistic tone in the industry for the coming year. It is reported that Ford will spend $2,000,000 on new equipment, increase the River Rouge plant capacity 50 per cent and eliminate the early morning work-shift.

Following considerable redesigning, the small Continental car is to become a Graham light six with most motor parts machined by Continental and assembled by Graham and the body following the Graham lines; transmission and differential are by Spicer. A 110-in. wheelbase is indicated. With slight changes, the same engine is expected to be used for the production of a light truck by a different manufacturer.

Last week Chevrolet added a four-door sedan to the standard series to sell for $540, which is similar to the master series except for knee-action. A wider price range is announced for the 1935 series Hupmobile cars which implies that this company is also to reach down into the low priced field now dominated by the big three.

Factory volume is not the only factor in this movement, however. The maintenance of profitable dealer outlets is an ever pressing problem as witnessed by the proposal to sell Willys cars through present Hupp dealers. There is at present no final news as to whether this deal will go through. Development of neighborhood sales-service stations where dealers sell gas and make minor repairs, a practice prohibited in the good old days, attempts to hold dealers in line and make their connections more profitable. A prospect list is also more readily developed by such a tie-up. The sale and servicing of Reo trucks by Mack-International Truck Co. announced last week is indicative of the movement among independents for strengthening of positions in the field. Rumor has it that there is a movement toward group purchases of material, but the practical difficulties in such a plan are likely to keep it in the rumor stage.

The Lubricants Division of the Society of Automotive Engineers announces that greater ease in starting this winter will result from use of 10 W and 20 W crankcase oils. These oils are classified on the characteristics of oils at zero instead of 130 deg. as was the case with the older designations.

Packard announces that by the end of the year $3,500,000 will be spent on

Exports of Machinery During September, 1934

	September 1934	August 1934	September 1933
Electrical machinery	$5,367,573	$5,971,444	$3,871,465
Power generating machinery (except automotive and electric)	480,696	591,258	312,155
Construction and conveying machinery	471,093	500,490	174,033
Mining, well and pumping machinery	2,895,191	2,278,572	1,218,137
Power-driven, metal-working machinery	1,204,527	1,546,157	625,118
Other metal-working machinery	142,634	147,806	83,234
Textile machinery	611,803	615,788	421,904

Exports of Metal-Working Machinery During September, 1934

	September 1934	August 1934	September 1933
Engine lathes	$38,215	$19,794	$19,858
Turret lathes	58,191	32,121	14,563
Other lathes	63,827	97,063	9,685
Vertical boring mills and chucking machines	38,654	48,638	3,524
Thread-cutting and automatic screw machines	70,045	117,639	32,066
Knee and column type milling machines	71,556	52,962	15,933
Other milling machines	54,905	73,934	18,857
Gear-cutting machines	52,334	90,382	67,059
Vertical drilling machines	17,318	4,597	10,553
Radial drilling machines	2,640	7,355	3,068
Other drilling machines	55,162	46,641	36,435
Planers and shapers	9,581	12,798	1,100
Surface grinding machines	31,520	34,030	10,611
External cylindrical grinding machines	31,435	76,064	9,295
Internal grinding machines	32,093	60,956	2,170
Tool grinding, cutter grinding, and universal grinding machines	37,266	41,115	20,012
Other metal-grinding machines	35,729	26,414	21,345
Sheet and plate metal-working machines	101,156	237,577	48,475
Forging machinery	130,391	101,562	59,350
Rolling mill machinery	65,769	95,119	35,090
Foundry and molding equipment	28,815	84,515	44,644
Other power-driven metal-working machinery and parts	177,895	184,881	122,425

Other Metal-Working Machinery

Pneumatic portable tools	37,101	34,642	20,321
Other portable and hand or foot operated metal-working machines and parts	42,505	45,881	26,017
Chucks for machine tools	11,209	8,608	4,581
Machine-operated pipe and thread cutters, stocks, dies, taps, and other machine-operated tools	32,617	40,209	17,218
Other metal-working machine tools	19,202	18,466	15,097

tooling for both cars; $1,200,000 for engineering, $1,000,000 for equipment and $500,000 for plant rearrangement. W. M. Parker, formerly regional manager for Chevrolet, becomes sales manager for the new smaller Packard and G. T. Christopher, vice-president in charge of manufacturing.

D. N. Benedict Heads Refrigerating Association

At the twenty-first annual meeting of the Refrigerating Machinery Association, held at the Stevens Hotel, in Chicago, October 22 and 23, D. Norris Benedict, vice-president and general manager of the Frick Company, was elected president to succeed W. S. Shipley, head of the York Ice Machinery Corporation. J. M. Fernald, general manager, Baker Ice Machine Co., was elected vice-president of the Association.

In addition to these officers, the new executive committee is composed of the following: A. H. Baer, vice-president, Carbondale Machine Corporation, G. A. Heuser, secretary-treasurer, Henry Vogt Machine Co., J. I. Lyle, president, Carrier Corporation, Emil Vilter, president, the Vilter Manufacturing Co.

It was unanimously decided to hold the spring meeting of the association at Hot Springs, Va., May 23-25, 1935.

Ralph Flanders to Speak Before Tool Engineers

At a meeting of the American Society of Tool Engineers to be held at the Fort Shelby Hotel, Detroit, Ralph E. Flanders, president of the Jones & Lamson Machine Co., will be the chief speaker. His subject will be "The Machine Tool Industry and Its Relationship to the Automotive Industry."

H. P. Charlesworth Made Council Chairman

At a meeting of the board of the Engineering Foundation the following were elected to fill the unexpired portion of terms ending on February 21, 1935:

Chairman—Harry P. Charlesworth, A.I.E.E., Assistant Chief Engineer, American Telephone and Telegraph Co.

First Vice-Chairman—D. Robert Yarnall, American Society of Mechanical Engineers; member of firm, Yarnall-Waring Co.

Second Vice-Chairman—Edwards R. Fish, member-at-large; A.S.M.E.; Hartford Steam Boiler Inspection and Insurance Company, chief engineer, boiler division.

Representative on National Research Council—Harry P. Charlesworth.

Printing Equipment Makers Re-Elect Officers

The entire slate of officers, headed by Arthur Bentley of the Miehle Printing Press & Manufacturing Co., was re-elected at the annual meeting of the National Printing Equipment Association, held in Chicago on October 17. Fred S. Tipson, secretary and treasurer of the T. W. and C. B. Sheridan Co., and Walter A. Sittig, secretary and treasurer of the H. B. Rouse & Co., were elected directors for a term of three years.

Packaging Machinery Institute Chooses New Directors

At the second annual meeting of the Packaging Machinery Manufacturers Institute, held October 12-13 at the Edgewater Beach Hotel, Chicago, the following new directors were elected: Kendall D. Doble, vice-president, Pneumatic Scale Corporation, Ltd.; C. E. Schaeffer, sales manager, Stokes & Smith Co., and Wallace D. Kimball, vice-president and general manager, Standard-Knapp Corporation. Subsequently the board of directors re-elected all the old officers to serve for another year.

At the annual dinner, guest speakers were W. J. Donald, former vice-president and treasurer of the Institute and J. T. Cheney, NRA assistant deputy administrator for the packaging code.

• INDUSTRIAL REVIEW •

• Although several industrial centers report discouragement that the autumn revival in machinery sales has not come up to expectations, there is no question but that November opens with more business in sight, and decidedly better sentiment than was evidenced a month ago. Almost everyone in the trade looks upon Election Day as the last hurdle and expects more interest on the part of customers now that politics can be given a brief rest until Congress convenes. Optimism on the part of automobile manufacturers and the leaders in the electrical industry is contagious.

• In the East machine tool distributors report hardly any activity of moment. The first week of November was quiet and the principal hope for business lies in the placing of orders for arsenal equipment which will be done this month. Pittsburgh distributors are not much more hopeful. October was dull and though there are some prospects for November improvement they are not very sturdy ones. In northern New York State business has been fairly brisk, thanks largely to the business machinery plants which continue active.

• Cleveland expects better things of November, based on both the quality and quantity of inquiries. Reports from salesmen are definitely more encouraging. In Detroit the welfare list is almost at its peak but the aggressive plans of the big automobile manufacturers for 1935 programs are bringing generally better feeling and improvements in supply buying, orders for special machinery, and tool and die shop activity. While machine tool orders in Toledo are dull the number of inquiries out is considerable and supply business is better.

• A brighter outlook characterizes Cincinnati in spite of few orders and shortening of hours in several machine tool plants. Conditions are better than they were a month ago. Small plants in Indianapolis are busy and business in general is expected to be fair for the remainder of the year. St. Louis also reports some improvement but machine tool orders lag behind supply business. Chicago dealers report some thinning of the clouds of gloom that have prevailed recently. Prospects are still numerous although closings have been few.

• Milwaukee is not optimistic although several companies report some business immediately ahead. Watchful waiting has marked the attitude in California. Many plants are sorely in need of replacements but owners refuse to act until business is better. Seattle reports a scarcity of orders in the Northwestern territory but finds business better than it was a year ago.

Ambitious Program Planned for A.S.M.E. Annual Meeting

Outdoing its previous efforts in drawing up a comprehensive program, the program committee of the American Society of Mechanical Engineers has projected an extremely interesting range of topics for the annual meeting to be held in New York City, September 3-6. A high spot in the program will be the memorial lecture to the late Calvin W. Rice, which will be on the subject of Dr. Rice's contribution to international friendliness.

The Towne lecture will be delivered by Dexter S. Kimball, past-president of the society and dean of the College of engineering, Cornell University. The Gantt medals will be presented to Wallace Clark and to Horace Cheney, in the Stevens Institute auditorium on December 6.

A summary of the program follows: Monday, December 3 will be devoted to Council Meetings at 10 a.m. and at 8 p.m., and a business meeting at 2 p.m. Unless otherwise noted all events will be held at the Engineering Societies Building, 29 West 39th St., New York City.

TUESDAY, DECEMBER 4

9:30 a.m. — Welding vs. Casting

WELDING, by Everett Chapman, Lukenweld, Inc.

USERS' VIEWPOINT, by Sol Einstein, Cincinnati Grinders, Inc.

9:30 a.m. — Heat Transfer

AUTOMOBILE COOLING, by L. P. Saunders, chief engineer, Harrison Radiator Corporation.

HEAT TRANSFER IN THE DAIRY INDUSTRY, by Harvey Feldmeier, Cherry-Burrell Corporation.

HEAT EXCHANGERS IN THE DAIRY INDUSTRY, by R. L. Berry, University of California.

9:30 a.m. — Railroad—I

TRACTIVE EFFORT OF STEAM LOCOMOTIVES (Locomotive Ratios—II), by A. Lipetz, American Locomotive Co.

LOCOMOTIVE TRACTIVE EFFORT IN RELATION TO SPEED AND STEAM SUPPLY, by E. J. Young and C. P. Pei.

9:30 a.m. — Bearing Analysis

EFFECTS OF SIDE LEAKAGE IN 120-DEG. CENTRALLY SUPPORTED JOURNAL BEARINGS, by Sidney J. Needs, Kingsbury Machinery Works.

PERFORMANCE OF LARGE JOURNAL BEARINGS, by R. Beaudry and L. M. Tichvinsky, Research Laboratory, Westinghouse Electric & Manufacturing Co.

9:30 a.m. — Apprenticeship Training

AN OPPORTUNITY ANALYSIS OF COLLEGE GRADE OCCUPATIONS COMPARED WITH THOSE OF THE PROFESSIONAL ENGINEER, by Marion B. Richardson, Ahrens & Richardson.

THE APPRENTICE SCHOOL IN INDUSTRIAL EDUCATION, by Don F. Smith, general superintendent, General Electric Co., Erie Works.

DISCUSSION OF INDUSTRIAL TRAINING UNDER NRA.

9:30 a.m. — Fans

AIR FLOW IN FAN DISCHARGE DUCTS, by Lionel S. Marks, professor of mechanical engineering, Harvard University.

PULSATING AIR FLOW, by Neil P. Bailey, Iowa State College.

PROGRESS REPORT ON FAN RESEARCH AT LEHIGH UNIVERSITY, by W. E. Somers, Lehigh University.

STATUS OF TEST CODES FOR FANS, by M. C. Stuart, Lehigh University.

THE INTAKE ORIFICE AND A PROPOSED METHOD FOR TESTING EXHAUST FANS, by N. C. Ebaugh and R. Whitfield, Georgia School of Technology.

2 p.m. — Domestic Heating

EXPERIENCE WITH APPLICATION OF CENTRAL-STATION PRACTICE TO DOMESTIC HEATING, by M. K. Drewry, assistant chief engineer of power plants, Milwaukee Electric Railway & Light Co.

THE USE OF OIL IN DOMESTIC HEATING, by L. E. Seeley, professor of mechanical engineering, Yale University.

THE USE OF GAS IN DOMESTIC HEATING, by R. B. Leckie, professor of gas engineering, Purdue University.

2 p.m. — Safety

THE PROBLEMS OF OCCUPATIONAL DISEASES IN INDUSTRY, by F. Robertson Jones, general manager, Association of Casualty and Surety Executives.

THE ADMINISTRATION OF OCCUPATIONAL DISEASE CONTROL, by Dr. Albert S. Gray, director, Bureau of Occupational Diseases, Department of Health, Hartford, Conn.

ORIGIN AND SOURCE OF TOXIC DUST FROM VARIOUS INDUSTRIES, by R. F. Stratton, The Travelers Insurance Co.

DUST CONTROL, PRESENT AND FUTURE DESIGN, by Theodore Hatch, instructor of sanitary engineering, Harvard School of Public Health.

ENGINEERING METHODS OF PREVENTION OF OCCUPATIONAL DISEASES OTHER THAN CAUSED BY TOXIC DUST.

2 p.m. — Railroad—II

DRAFT GEAR ACTION IN LONG TRAINS, by O. R. Wikander, mechanical engineer, Ring Spring Department, Edgewater Steel Co.

ALLOY STEEL AND ITS APPLICATION TO CAR EQUIPMENT, by J. A. Ralston, manager, Railroad Research Bureau and the subsidiary manufacturing companies of the U. S. Steel Corporation, and A. F. Steubing, railroad mechanical engineer, U. S. Steel Corporation.

PROGRESS REPORT IN RAILROAD ENGINEERING, by G. W. Rink, assistant superintendent of Motive Power, Central Railroad of New Jersey.

2 p.m. — Bearing Practice

CURRENT PRACTICE IN PRESSURES, SPEEDS, CLEARANCES, AND LUBRICATION OF OIL-FILM BEARINGS, by H. A. S. Howarth, Kingsbury Machine Works.

2 p.m. — Materials

STRESS ANALYSIS OF FAILURES IN MACHINE PARTS, by F. A. Mickle and Dr. F. L. Everett, University of Michigan.

THE FATIGUE OF SHAFTS AT FITTED MEMBERS, by R. E. Peterson and A. M. Wahl.

PITTING OF METALLIC SURFACES DUE TO ROLLING CONTACT, by Stewart Way, Westinghouse Electric & Manufacturing Co.

STRENGTH AND DESIGN OF COVERS, AND FLANGES FOR VESSEL OPENINGS, by T. McLean Jasper, H. Gregerson and A. M. Zoellner, A. O. Smith Corporation.

2 p.m. — Heat Transfer—II

DISCUSSION OF THE STATUS OF HEAT TRANSFER BETWEEN LIQUID AND GAS IN CONTACT, by A. Weisselberg, consulting engineer.

INVESTIGATION OF HEAT TRANSFER RATES ON EXTERNAL SURFACE OF BAFFLED BANKS, by R. A. Bowman, Westinghouse Electric & Manufacturing Co.

REPORT ON RESEARCH IN COTTON-SEED OIL PROCESSING, by W. R. Woolrich, chief, industrial division, Tennessee Valley Authority.

2 p.m. — Engineering History

MOVEMENT FOR THE STUDY OF TECHNICAL HISTORY, by I. N. Liphshitz.

4:30 p.m. — Thurston Lecture

9:30 p.m. — Presidents' Night

WEDNESDAY, DECEMBER 5

9 a.m. — Industrial Power

FLOW DISTRIBUTION IN FORCED-CIRCULATION ONCE-THROUGH STEAM GENERATORS, by H. L. Solberg, G. A. Hawkins, and A. A. Potter, Purdue University.

INFLUENCE OF BENDS OR OBSTRUCTIONS AT THE FAN DISCHARGE OUTLET ON THE PERFORMANCE OF CENTRIFUGAL FANS, by L. S. Marks, J. H. Raub, and H. R. Pratt, Harvard University.

9:30 a.m. — Budgetary Control

FUNDAMENTALS OF BUDGETING, by Harold A. Hopf, H. A. Hopf & Co.

BUDGETING AND INDUSTRIAL ENTERPRISE, by Walter Rautenstrauch, professor of industrial engineering, Columbia University.

9:30 a.m. — Broaching

CURRENT PRACTICE IN SURFACE BROACHING, by Joseph Geschelin, engineering editor, Automotive Industries.

PROGRESS IN MACHINE SHOP PRACTICE, by R. E. W. Harrison, chief, Machinery and Agricultural Implements Division, Department of Commerce.

9:30 a.m. — Vibration

AN INVESTIGATION OF AXIAL OSCILLATIONS OF TURBINE-GENERATOR SPINDLES, by J. G. Baker, Westinghouse Electric & Manufacturing Co.

A MATHEMATICAL SOLUTION OF THE ROTOR-BALANCING PROBLEMS, by J. Bromberg.

EFFECT OF SKEWING AND POLE SPACING OF MAGNETIC NOISE IN ELECTRICAL MACHINERY, by S. J. Mikina, Westinghouse Research Laboratories.

DYNAMIC BALANCING OF ROTATING MACHINERY IN THE FIELD, by E. L. Thearle, Research Engineer, General Electric Co.

9:30 a.m. — Iron and Steel

MANUFACTURE OF LARGE SEAMLESS-STEEL TUBES BY THE TSCHULENK FORGE-ROLLING PROCESS, by Arthur J. Herschmann, U. S. A. agent for Vitkovice Steel Works of C.S.R., and L. Tschulenk, Czechoslovakia.

PROGRESS IN IRON AND STEEL ENGINEERING.

9:30 a.m. — Textile

SURVEY ON LUBRICANTS USED IN TEXTILE INDUSTRY, by C. H. Baxley and C. M. Larson, Sinclair Refining Co.

THE OPPORTUNITY FOR COST REDUCTION IN TEXTILE MANUFACTURING AND SELLING, by Sanford E. Thompson, president, the Thompson & Lichtner Co.

12:30 p.m. — Textile Luncheon Fraternity Clubs

ENGINEERING ASPECTS OF THE STRETCHOUT SYSTEM, by J. J. McElroy, superintendent, Maverick Mills.

2 p.m. — Fuels

PULVERIZED-FUEL BURNING EXPERIENCE AT BUZZARD POINT PLANT, by H. G. Thielscher, mechanical engineer, Potomac Electric Power Co.

THE ECONOMICS OF PREHEATED AIR FOR STOKERS, by R. E. Dillon, superintendent, Generating Department, and M. D. Engle, assistant to the superintendent, Stationary Engineering Department, the Edison Electric Illuminating Co.

THE RELATIVE GRINDABILITY OF COAL, by Harold J. Sloman and Arthur C. Barnhart, Carnegie Institute of Technology.

2 p.m. — Suggestion System

PHILOSOPHY AND ADMINISTRATION OF SUGGESTION SYSTEMS, by Z. C. Dickinson, professor of economics, University of Michigan.

OPERATION OF A SUGGESTION SYSTEM, by Virgil M. Palmer, engineer of industrial economy, Eastman Kodak Co.

2 p.m. — Metal Cutting

RELATION BETWEEN CUTTING FORCE, TEMPERATURE, AND TOOL LIFE WHEN CUTTING STEEL WITH A SINGLE-POINT TOOL, by O. W. Boston, and W. W. Gilbert, University of Michigan.

THE FORMATION AND FUNCTION OF THE BUILT-UP EDGE, by Hans Ernst, research engineer, Cincinnati Milling Machine Co.

PROGRESS REPORT OF SUBCOMMITTEE ON METAL-CUTTING DATA, secretary, subcommittee on Metal-Cutting Data.

2 p.m. — Stress Analysis

EXACT CONSTRUCTION OF THE $(\sigma_1 + \sigma_2)$ NETWORK FROM PHOTOELASTIC OBSERVATIONS, by Heinz P. Neuber.

NEW METHOD OF CALCULATING LONGITUDINAL SHEAR IN CHECKED WOODEN BEAMS, by J. A. Newlin, G. E. Heck and H. W. March, Forest Products Laboratories.

COLLAPSE BY INSTABILITY OF THIN CYLINDRICAL SHELLS UNDER EXTERNAL PRESSURE, by D. F. Windenburg, Assistant Physicist and Charles Trilling, U. S. Experimental Model Basin, Navy Yard, Washington, D. C.
PROGRESS IN APPLIED MECHANICS, by E. O. Waters, Professor of Mechanical Engineering, Yale University.

2 p.m. Steam Tables Research

REPORTS ON RESEARCH WORK.
REPORT ON INTERNATIONAL STEAM TABLE CONFRENCE.

2 p.m. Iron and Steel

WIRE ROPE RESEARCH REPORT, by special research committee.
LUBRICATION OF ROLLING MILLS—A Symposium.
LUBRICANTS USED BY BETHLEHEM STEEL CORPORATION, by J. F. Pelly, Bethlehem Steel Corporation.
STEEL MILL LUBRICATING, by B. S. Burrell, Inland Steel Co.
LUBRICANTS USED IN COPPER AND BRASS MILLS, by Walter Clark, general manager, Bridgeport Brass Co.

4:30 p.m. Calvin W. Rice Lecture

Dr. Calvin W. Rice's Contribution to International Friendliness.

6:30 p.m. Annual Dinner Hotel Astor

THURSDAY, DECEMBER 6

9:30 a.m. Central Station

HIGH-PRESSURE STEAM AND BINARY CYCLES AS A MEANS OF IMPROVING GAS POWER-STATION EFFICIENCY, by Gustaf A. Gaffert, assistant professor of heat-power engineering, Worcester Polytechnic Institute.
FLUID-METER NOZZLES, by B. O. Buckland, Turbine Engineering Department, General Electric Co.

9:30 a.m. Quality Control

ASPECTS OF QUALITY CONTROL, by W. A. Shewhart, Bell Telephone Laboratories.
CONTROL OF DISTRIBUTION, by T. H. Brown, Professor, Harvard University.
PROGRESS REPORT ON MANAGEMENT.

9:30 a.m. Boiler Feedwater—I

PROGRESS REPORT ON RESEARCH WORK ON DISSOLVED OXYGEN, by C. H. Fellowes, Detroit Edison Co.
NAVY'S EXPERIENCE WITH THE NEW BOILER COMPOUND, by R. C. Adams, Jr., U. S. Naval Experimental Sation, Annapolis, Md.

9:30 a.m. Aerodynamics

BOUNDARY LAYER FLOW NEAR FLAT PLATE, by Hugh L. Dryden, Bureau of Standards.
A NEW THEORY FOR BUCKLING OF THIN CYLINDERS UNDER AXIAL COMPRESSION AND BENDING, by L. H. Donnell, engineer in charge of stress analysis, Goodyear-Zeppelin Corporation.
FURTHER EXPERIMENTS ON THE VARIATION OF THE MAXIMUM-LIFT COEFFICIENT WITH TURBULENCE AND REYNOLDS' NUMBER, by Clark B. Millikan, Assistant Professor of Aeronautics, California Institute of Technology.
THE DESIGN AND PERFORMANCE OF AN AXIAL-FLOW FAN, by L. S. Marks, professor of mechanical engineering, and John R. Weske, Harvard Graduate School, Harvard University.
PROGRESS REPORT ON AERONAUTICAL ENGINEERING.

9:30 a.m. Sugar

MECHANICAL CIRCULATION IN VACUUM PANS, by Alfred L. Webre, United States Pipe and Foundry Co.

2 p.m. Central Station

THE TEST PERFORMANCE ON HUDSON AVENUE'S MOST RECENT STEAM-GENERATING UNITS, by P. H. Hardie and W. S. Cooper, Research Bureau, Brooklyn Edison Co.
TEN YEARS OF STOKER DEVELOPMENT AT HUDSON AVENUE, by J. M. Driscoll and W. H. Sperr, plant engineer and assistant plant equipment engineer, respectively, mechanical engineering department, Brooklyn Edison Co.
COAL CHARGES FOR BANKING, LIGHTING, AND BURNING OUT BOILER UNITS, by George C. Eaton, mechanical technical generating department, Edison Electric Illuminating Co.
PROGRESS IN POWER.

2 p.m. Oil and Gas Power

FUTURE OF THE LARGE MOTORSHIP, by Louis R. Ford, Editor, *Motorship*.
MAINTENANCE SCHEDULE IN A DIESEL CENTRAL STATION, by H. C. Major.
Adjourn to Auditorium for PROGRESS IN POWER.

2 p.m. Boiler Feedwater

CRITICAL SURVEY OF PUBLISHED INFORMATION RELATING TO THE EMBRITTLEMENT OF BOILER STEEL, by Everett P. Partridge and W. C. Schroeder, Non-Metallic Minerals Experimental Station, Bureau of Mines.
THE SOLUBILITY OF SODIUM SULPHATE IN BOILER-WATER SALINES AS RELATED TO THE PREVENTION OF EMBRITTLEMENT—Progress Report No. 3.
THE EFFECT OF SOLUTION COMPOSITION ON THE FAILURE OF HIGHLY STRESSED BOILER STEEL—Progress Report No. 1. Both reports by W. C. Schroeder and E. P. Partridge.

2 p.m. Mechanical Springs

DEVELOPMENT OF ELASTIC SPRINGS, by A. V. DeForest, consultant Chatillon & Son, and Massachusetts Institute of Technology.
NEW SPRING FORMULAS AND NEW MATERIALS IN PRECISION SPRING SCALE DESIGN, by Mortimer F. Sayre, associate professor of applied mechanics, Union College, and consulting engineer, John Chatillon & Son.
ANALYSIS OF DEFLECTION AND STRESS IN HELICAL COMPRESSION SPRINGS, by H. C. Keyser, mechanical engineer, American Steel Foundries.

2 p.m. Fluid Meters

CALIBRATION OF ROUNDED-APPROACH ORIFICES, by J. F. Downie Smith, instructor of mechanical engineering, Harvard University.
THE V-NOTCH WEIR FOR HOT WATER, by Ed. S. Smith, Builders Iron Foundry.
PROGRESS REPORT BY HYDRAULIC DIVISION.

PROGRAM AT STEVENS INSTITUTE, HOBOKEN, N. J.

3 p.m. Economics

DISCUSSION OF ENGINEERING ECONOMICS.

6 p.m. Invitation Dinner Castle Stevens

8 p.m. Gantt Medal Presentation Auditorium

Presentation of Gantt Medals to Wallace Clark by Dr. William N. Gilbreth, and to Horace Cheney, by Col. Malcolm Rorty.

8:30 p.m. Towne Lecture

By Dexter S. Kimball, past-president, A.S.M.E., dean of the College of Engineering, Cornell University.

• OBITUARIES •

FRANK JULIAN SPRAGUE, who installed the first electric railway system in the world at Richmond, Va., in 1887, died October 25, only a few days after having been awarded the John Fritz gold medal for 1935, by the American Institute of Electrical Engineers. In 1884 he organized the Sprague Electric Railway and Motor Co., was the first to engage in the general manufacture and introduction of industrial electric motors. For many years Mr. Sprague was consulting engineer for the Sprague, Westinghouse, Otis and General Electric Companies.

L. J. BETTS, 70, president of the Betts Foundry & Machinery Co., Warren, Pa., died October 20. With C. S. FAIRCHILD, he founded the firm of Fairchild & Betts in 1901, and when Mr. Fairchild retired 14 years ago, the firm was continued as the Betts Foundry & Machinery Co.

HARRY R. SINCLAIR, president of the Worcester Stamped Metal Co., Worcester, Mass., died October 11 at the age of 62. He became president of the company in 1916 when it succeeded the W & S Manufacturing Co.

ROBERT C. WILLIAMS, 59, former factory superintendent of the Brown Lipe Gear Company and E. C. Stearns & Co., Syracuse, N. Y., died October 21.

• PERSONALS •

CARL M. KALTWASSER, formerly general manager of the Salisbury Axle Division of the Spicer Mfg. Co., and later identified in an executive capacity with the Timken Axle Co., Detroit, has been appointed executive vice-president in charge of operations of the New York Shipbuilding Co., Camden, N. J. For the past ten months he has been identified with the E. L. Cord interests which control the New York Shipbuilding Company.

RUFUS S. COLE has been made executive vice-president and general manager of the Hupp Motor Car Corp. WALTER ROE has been named chief master mechanic. For a number of years he was connected with the Oakland Motor Car Co.

F. R. FISHBACK, president, the Electric Controller & Mfg. Co., Cleveland, was elected vice-president of the National Electrical Manufacturing Association at the annual convention.

FRANK J. JOHNSON, president and a founder of the American Hoist & Derrick Co., St. Paul, Minn., resigned recently. FREDERIC CROSBY has been elected president, and HOWARD S. JOHNSON remains as vice-president.

CHARLES E. STUART, president of the Tyson Roller Bearing Co. for five years, has resigned. RUSSELL E. COLGATE, who has been chairman, has been elected president and treasurer. RALPH H. MAXSON is executive vice-president in charge of operations. E. R. EARNEST is assistant treasurer and purchasing agent.

RALPH R. WEDDELL, who recently returned from England after establishing there the manufacture of serrated blade cutters, is now connected with the Ingersoll Milling Machine Co., Rockford, Ill., in charge of design and sale of small tools.

FRED B. SMITH, salesman for the Hendey Machine Co., Torrington, Conn., was recently congratulated by the company for 50 years of service. In 1884 he started work as an apprentice, became a journeyman machinist and later fore-

Corporation Reports

Company	1934 Earnings Third Quarter	1934 Earnings Nine Months	1933 Earnings Third Quarter	1933 Earnings Nine Months
Allis-Chalmers Mfg.	d$84,923	d$907,176	d$581,532	d$2,040,439
Auburn Automobile	d$679,066*	d$2,324,532*	d$354,154*	d$1,463,711*
Borg-Warner	$570,724	$2,521,252	$650,931	$986,103
E. G. Budd Mfg.	d$152,048	d$87,282	$50,298	d$253,252
Budd Wheel	d$32,480	$116,129	$24,307	d$262,775
Cincinnati Ball Crank	d$10,507	d$24,081	d$8,247	d$53,952
Ex-Cell-O Aircraft & Tool	d$53,536	$146,659	d$82,315	d$182,070
Federal Screw	d$10,249	d$13,324	d$18,082	d$155,570
Graham-Paige	$1,847	$21,852	$122,306	$145,934
Gillette Safety Razor	$1,192,712	$3,158,790	$453,278	$2,666,164
Hayes Body	d$98,902	d$104,623	d$75,322	d$273,443
Houdaille-Hersey	$128,016	$853,824	$118,664	$76,027
Hupp Motor Car	d$923,994	d$2,40,,361	d$414,699	d$1,196,131
International Business Machines	$1,652,338	$5,053,514	$1,476,136	$4,378,148
Link-Belt	$194,667	$573,406	$254,875	$52,130
Marion Steam Shovel	d$83,708	d$345,991	d$140,295	d$469,816
Mesta Machine	.....	†$463,085	.....	.....
Minneapolis Honeywell Regulator	$346,292	.....	$385,932	.....
Motor Wheel	$5,008	$613,908	$198,201	$313,293
L. C. Smith & Corona Typewriters	.....	†$150,230	.....	†d$376,738
Otis Elevator	$101,193	d$194,031	d$230,157	d$1,257,893
Westinghouse Air Brake	$198,372	$240,406	d$236,210	d$518,781
Yale & Towne Mfg.	d$70,251	d$8,256	$27,626	d$161,791
Yellow Truck & Coach	d$510,976	d$238,582	$40,262	d$1,148,069

d—Deficit.
*—Nine months ended August 31.
†—Six months ended June 30.

nan of the shaper department. He was sent to the Paris exposition in 1900, and installed the company's exhibit at the St. Louis exposition in 1904. It was, however, as a traveling salesman working chiefly in his home state that Mr. Smith has established himself.

PAUL M. WEISS has been made assstant works manager of the Chicago plant of the Crane Co. He was formerly general business manager of the North Tonawanda plant.

• BUSINESS ITEMS •

Fleetwings, Inc., has purchased the plant of the Keystone Aircraft Corp. at Bristol, Pa.

The Yates-American Machine Co., has commenced the manufacture of heat transfer units of all types, including a full line of unit heaters for heating purposes and also automotive radiators, according to an announcement by ALVIN HAAS, vice-president and general manager.

The Simmons Machine Tool Corp. has doubled the capacity of its Albany warehouses, and has installed an additional overhead crane to facilitate shipment of rebuilt machine tools. Floor space is now about 75,000 sq.ft., and over 2,500 machines are in stock.

Electro Lift, Inc., 30 Church St., New York, N. Y., manufacturers of monorail electric hoists and cranes, has moved its plant to Bloomfield, N. J., where larger facilities are available.

Magnetic Manufacturing Co., Milwaukee, Wis., manufacturers of magnetic clutches and separators, has appointed Garrett Burgess, Inc., 5050 Joy Road, Detroit, Mich., to handle the company's entire line, and to give complete service pertaining to the installation and use of this equipment.

• MEETINGS •

AMERICAN ENGINEERING COUNCIL. Annual meeting, Jan. 10-12. Washington, D. C. FREDERICK M. FEIKER, executive secretary, 744 Jackson Place, N. W., Washington, D. C.

INTERNATIONAL ACETYLENE ASSOCIATION. Annual meeting, Nov. 14-16. William Penn Hotel, Pittsburgh, Pa. H. F. REINHARD, secretary, 30 East 42nd St., New York, N. Y.

MOTOR AND EQUIPMENT MANUFACTURERS ASSN. Annual meeting, Nov. 19-23. Cleveland Hotel, Cleveland, Ohio. A. H. EICHOLZ, general manager, 250 West 57th St., New York, N. Y.

NATIONAL ASSN. OF BOTTLING MACHINERY MANUFACTURERS. Annual meeting, Jan. 14. Hotel Statler, Buffalo, LOUIS B. MONTFORT, secretary, 218 Munsey Bldg., Washington, D. C.

NATIONAL ASSOCIATION OF MANUFACTURERS. Annual meeting, Dec. 5-6. Waldorf-Astoria Hotel, New York. WALTER B. WEISENBURGER, executive vice-president, 11 West 42nd St., New York, N. Y.

POWER SHOW. Eleventh national exposition of power and mechanical engineering. Dec. 3-8. Grand Central Palace, New York. CHARLES F. ROTH, manager, Grand Central Palace.

SOCIETY OF AUTOMOTIVE ENGINEERS. Tractor and industrial power equipment meeting, Dec. 5-6. Stevens Hotel, Chicago. Thirtieth anniversary dinner, Jan. 7. Hotel Commodore, New York. Annual meeting, Jan. 14-18. Book-Cadillac Hotel, Detroit. JOHN A. C. WARNER, secretary, 29 West 39th St., New York.

• PATENTS •

October 16, 1934

Metal-Working Machinery

Automatic Grinding and Polishing Machine. William V. Robinson, Owosso, Mich. Patent 1,976,805.

Machine for Grinding Gears. Frederick A. Ward, Detroit, Mich., assigned to the Gear Grinding Machine Co. Patent 1,976,818.

Gear Cutting Machine. Robert S. Condon and Albert P. Schauseil, Rochester, N. Y., assigned to Gleason Works. Patent 1,976,984.

Grinding Machine. Owen Doutt, Detroit, Mich., assigned to General Spring Bumper Corp. Patent 1,977,049.

Header or Upsetting Machine. Richard L. Wilcox, Waterbury, Conn., assigned to the Waterbury Farrel Foundry & Machine Co. Patent 1,977,161.

Method of Making Articles Having a Polygonal Cross-Section. Richard L. Wilcox, Waterbury, Conn., assigned to the Waterbury Farrel Foundry & Machine Co. Patent 1,977,162.

Die Mechanism. Richard L. Wilcox, Waterbury, Conn., assigned to the Waterbury Farrel Foundry & Machine Co. Patent 1,977,163.

Means for Making Articles Having a Polygonal Cross-Section. Richard L. Wilcox, Waterbury, Conn., assigned to the Waterbury Farrel Foundry & Machine Co. Patent 1,977,164.

Metal Working Press. Rudolph W. Glasner, Chicago, Ill. Patent 1,977,549.

Tools and Attachments

Cutter Head for Boring Machines. Mikal A. Haram and John M. Lundell, Minneapolis, Minn., assigned to Storm Manufacturing Co., Inc. Patent 1,977,058.

Chuck. Blanche H. Williams, Barcroft, Va. Patent 1,977,363.

October 23, 1934

Metal-Working Machinery

Grinding Machine. Albert Vuilleumier, Bristol, Conn., assigned to General Motors Corp. Patent 1,977,747.

Cutting Machine. Charles B. Gray, Millbourne, Pa. Patent 1,977,795.

Automatic Stop for Extrusion Presses. Marcus A. Fair, Englewood, N. J., assigned to Aluminum Company of America. Patent 1,977,824.

Automatic Chucking Machine. Harry J. Hauck and Stanley T. Goss, New Britain, Conn., assigned to the Goss & De Leeuw Machine Co. Patent 1,977,964.

Cutting-Off Machine. August A. Rickert, Erie, Pa., assigned to Rickert-Shafer Co. Patent 1,978,059.

Work Feeding Device. August A. Rickert, Erie, Pa., assigned to Rickert-Shafer Co. Patent 1,978,060.

Grinding Machinery. Bernard A. Kearns, Cincinnati, Ohio, assigned to Cincinnati Grinders, Incorporated. Patent 1,978,110.

Grinding Machine. Frederick S. Haas, Cincinnati, Ohio, assigned to Cincinnati Grinders, Incorporated. Patent 1,978,132.

Hydraulically Driven Surface Grinding Machine. Joseph R. Whittles, Rockford, Ill., assigned to Norton Co. Patent 1,978,181.

Process of Cutting Threads and Machine Therefor. Frederick W. Brehmer, Cincinnati, Ohio, assigned to Frank M. Andrews, Stanley G. Clark, and William G. Funk. Patent 1,978,248.

Machine for Grinding Cylindrical Bodies. William Ogilvie, Copt Heath, Knowle, England, assigned to B. S. A. Tools, Limited, Birmingham, England. Patent 1,978,279.

Profiling Machine. Frederick V. Geier and Walter D. Archea, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,978,347.

Automatic Milling Machine. Lester F. Nenninger and Fred A. Hassman, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,978,353.

Milling Machine Transmission Control Mechanism. Lester F. Nenninger and Bernard Sassen, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,978,354.

Milling Machine. Walter D. Archea, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,978,360.

Milling Machine. Millard Romaine, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,978,373.

Milling Machine. Millard Romaine and Walter D. Archea, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,978,374.

American Machinist

REFERENCE BOOK SHEET ©

Proposed American Standard Preferred Numbers

Sectional Committee Z17, the American Standards Association, offers this series of preferred numbers for criticism and comment by industry. The proposal comprises several tables in the decimal as well as in the binary system. The following is quoted from the report in the *Industrial Standardization and Commercial Standards Monthly*, October, 1934:

Explanation of "Preferred Numbers" System

It is more or less obvious that any line of machines, apparatus, or devices should be based, at least within certain ranges, either with regard to its principal dimension or ratings, on a geometric series. This simply means that any rating in the line within certain ranges should be a fixed percentage larger than the preceding one. If this practice were followed indiscriminately, however, the natural consequence would be that a great number of different percentage figures would be used for this purpose.

The "Preferred Numbers" system is an attempt to bring about a standardization of these percentage figures and it therefore establishes certain series of figures advancing by these standardized percentages, which should always be used in preference to other figures not contained in these series. This system provides the so-called "5 series," having five uniform steps of approximately 60 per cent between 1 and 10; the "10 series," having ten steps of approximately 25 per cent; the "20 series," having twenty steps of approximately 12 per cent; etc.

Mathematically, the factor by which each figure is multiplied to obtain the next higher figure has been established as follows:

For the 5 series, $\sqrt[5]{10}$, or 1.5849

For the 10 series, $\sqrt[10]{10}$, or 1.2589

For the 20 series, $\sqrt[20]{10}$, or 1.1220

For the 40 series, $\sqrt[40]{10}$, or 1.0592

Guiding Suggestions in the Use of Preferred Numbers

1. Fractional preferred numbers are intended for use chiefly in connection with linear dimensions where found desirable.

Decimal preferred numbers should preferably be used for ratings, commercial capacities such as cubic content, weights, etc.

Decimal preferred numbers should preferably be used for dimensions below .10 in. and especially in connection with gauges for raw materials in this range, also when the metric or the decimal inch system is used.

2. If both machined and raw material dimensions are involved, preferred numbers should be applied first to the machined dimensions, and to the raw material dimensions only if this can be done without economic waste.

3. In the case of mating parts, such as bolts, studs, rotating bodies, etc., and the bore in connection with which they are used, preferred numbers should be used for the internal members, but for the bore of the holes only if this can be done without handicapping the design or resulting in economic waste.

4. There are certain practical cases where the 60 per cent steps of the fundamental series are smaller than economically justified. There may also be cases where percentage increases between the 60 and 25 per cent steps or between the 25 and 12 per cent steps are desirable or necessary for some reason or other. For such cases supplementary series may be constructed by using for instance every third member in the ten series and thus obtaining a 100 per cent increase, every third member in the 20 series and thus obtaining a 40 per cent increase, etc. This results in the following possibilities:

PREFERRED NUMBERS — FUNDAMENTAL DECIMAL SERIES

TABLE NO. 1

1 to 10				
5 Series 60%	10 Series 25%	20 Series 12%	40 Series 6%	Values to 5 figures
1.0	1.0	1.0	1.0	10 000
			1.05	10 593
		1.10	1.10	11 220
			1.17	11 885
	1.25	1.25	1.25	12 589
			1.32	13 335
		1.4	1.40	14 125
			1.50	14 962
1.6	1.6	1.6	1.60	15 849
			1.70	16 788
		1.8	1.80	17 783
			1.90	18 836
	2.0	2.0	2.00	19 953
			2.10	21 135
		2.2	2.20	22 387
			2.35	23 714
2.5	2.5	2.5	2.50	25 119
			2 65	26 607
		2.8	2.8	28 184
			3.0	29 854
	3.2	3.2	3.2	31 623
			3.4	33 497
		3.6	3.6	35 481
			3.8	37 584
4.0	4.0	4.0	4.0	39 811
			4.2	42 170
		4.4	4.4	44 668
			4.7	47 315
	5.0	5.0	5.0	50 119
			5.3	53 088
		5.6	5.6	56 234
			6.0	59 566
6.4	6.4	6.4	6.4	63 096
			6.8	66 834
		7.2	7.2	70 795
			7.6	74 989
	8.0	8.0	8.0	79 433
			8.5	84 140
		9.0	9.0	89 125
			9.5	94 406
10.0	10.0	10.0	10.0	10 000

Preferred Numbers below 1.0 are formed by dividing the numbers between 1 and 10 by 10, 100, etc. Preferred numbers above 10 are correspondingly formed by multiplication of the numbers between 1 and 10 by 10, 100, etc.

Percentage Figures in headings are approximate averages.

Proposed American Standard Preferred Numbers

Per Cent Increase Approx.	Steps
300	3rd Step in 5 series
150	2nd " " 5 "
100	3rd " " 10 "
60	Every " " 5 "
40	3rd " " 20 "
25	Every " " 10 "
18	3rd " " 40 "
12	Every " " 20 "
6	Every " " 40 "

All series start with 1 going up or down.

PREFERRED NUMBERS — FUNDAMENTAL FRACTIONAL SERIES

TABLE NO. 2

1/16 to 1			
5 Series 60%	10 Series 25%	20 Series 12%	40 Series 6%
1/16	1/16		
	5/64		
3/32	3/32	3/32	
		7/64	
	1/8	1/8	
		9/64	
5/32	5/32	5/32	
		11/64	
	3/16	3/16	3/16
			13/64
		7/32	7/32
			15/64
1/4	1/4	1/4	1/4
			17/64
		9/32	9/32
			19/64
	5/16	5/16	5/16
			21/64
		11/32	11/32
			23/64
3/8	3/8	3/8	3/8
			13/32
		7/16	7/16
			15/32
	1/2	1/2	1/2
			17/32
		9/16	9/16
			19/32
5/8	5/8	5/8	5/8
			21/32
		11/16	11/16
			23/32
	3/4	3/4	3/4
			13/16
		7/8	7/8
			15/16
1	1	1	1

Note: Between 1/16 and 3/32 the steps of the 20 and 40 series, and between 3/32 and 3/16 the steps of the 40 series are omitted, as finer gradations will seldom be used.

Percentage figures in headings are approximate averages.

TABLE NO. 3

1 to 14			
5 Series 60%	10 Series 25%	20 Series 12%	40 Series 6%
1	1	1	1
			1 1/16
		1 1/8	1 1/8
			1 3/16
	1 1/4	1 1/4	1 1/4
			1 5/16
		1 3/8	1 3/8
			1 7/16
1 1/2	1 1/2	1 1/2	1 1/2
			1 5/8
		1 3/4	1 3/4
			1 7/8
	2	2	2
			2 1/8
		2 1/4	2 1/4
			2 3/8
2 1/2	2 1/2	2 1/2	2 1/2
			2 5/8
		2 3/4	2 3/4
			2 7/8
	3	3	3
			3 1/4
		3 1/2	3 1/2
			3 3/4
4	4	4	4
			4 1/4
		4 1/2	4 1/2
			4 3/4
	5	5	5
			5 1/4
		5 1/2	5 1/2
			5 3/4
6	6	6	6
			6 1/2
		7	7
			7 1/2
	8	8	8
			8 1/2
		9	9
			9 1/2
10	10	10	10
			10 1/2
		11	11
			11 1/2
	12	12	12
			13
		14	14

Note: Above 14 the fractional preferred numbers are the same as the decimal preferred numbers, which will be multiples of the numbers shown in table No. 1.

5. It is not only permissible but often desirable to pass over from one series of "Preferred Numbers" to an adjacent series where economical or technical considerations indicate such a course.

6. The application of Preferred Numbers is not restricted to a series of figures, but even when a few or only one value is required, this value should be chosen from the Preferred Numbers series, giving preference to the figures in the 5 series to those of the 10 series, etc.

7. Although the preferred numbers offer an excellent means to the individual manufacturer for standardizing parts and important internal dimensions of his products, the principal and most importat applications of preferred numbers should be looked for in connection with figures of interest to the purchaser and user, such as gauge dimensions and sizes of materials, overall dimensions of machines, apparatus, and articles of all kinds, ratings, commercial capacities, speeds, etc.; in other words preferred numbers should be used wherever the interchangeability of goods made by different manufacturers is of interest to the user.

PREFERRED NUMBERS — SUPPLEMENTARY

TABLE NO. 4

1 to 1000—Decimal Series			
1 2/3 Series 300%	3 1/3 Series 100%	6 2/3 Series 40%	13 1/3 Series 18%
1	1	1.0	1.0
			1.17
		1.4	1.4
			1.7
	2	2.0	2.0
			2.35
		2.8	2.8
			3.4
4	4	4.0	4.0
			4.7
		5.6	5.6
			6.8
	8	8	8.0
			9.5
		11	11
			13.2
16	16	16	16
			19
		22	22
			26.5
	32	32	32
			38
		44	44
			53
64	64	64	64
			76
		90	90
			105
	125	125	125
			150
		180	180
			210
250	250	250	250
			300
		360	360
			420
	500	500	500
			600
		720	720
			850
1000	1000	1000	1000

TABLE NO. 5

1/16 to 16—Fractional Series			
1 2/3 Series 300%	3 1/3 Series 100%	6 2/3 Series 40%	13 1/3 Series 18%
1/16	1/16		
	1/8	1/8	
		11/64	
1/4	1/4	1/4	1/4
			19/64
		11/32	11/32
			13/32
	1/2	1/2	1/2
			19/32
		11/16	11/16
			13/16
1	1	1	1
			1 3/16
		1 3/8	1 3/8
			1 5/8
	2	2	2
			2 3/8
		2 3/4	2 3/4
			3 1/4
4	4	4	4
			4 3/4
		5 1/2	5 1/2
			6 1/2
	8	8	8
			9 1/2
		11	11
			13
16	16	16	16

Preferred numbers below 1 of the decimal series are formed by dividing the numbers between 1 and 1000 by 1000. Preferred numbers above 1000 are formed by multiplying the numbers between 1 and 1000 by 1000.

Above 16 the fractional Preferred Numbers are the same as the decimal Preferred Numbers.

A 150% increase is obtained by using every second step in the five series, starting with 1 going up or down.

Percentage figures in headings are approximate averages.

Johnson Goes Light on Guarantees

JOHN R. GODFREY

MY HAT'S off to General Bill Whosit. He's a glutton for punishment and came back to see Old Man Johnson the other day for more dope on specifications. And he wants to have them right—or as nearly right as he can under the regulations, which, unfortunately, have to be drawn to keep the small percentage of crooks from gouging the government.

"Tom," began the general, "I've been thinking a lot of the lambasting you gave me the other day (*AM*—Vol. 78, page 577). Been letting it soak into my system, and several of my officers are interested, too. Now I'd like to get your slant on our idea of guarantees." And he handed one to Tom.

"Guarantees are funny animals, Bill. They usually cover too much or too little. Just take these you have here. Guarantees of both gross and net production and a 'guarantee of maximum percentage of rejects.'"

"Well, what ails them, Tom? We want to know what we can count on."

"Sure, Bill. And the maker will be glad to guarantee all you ask as long as he has any control of production. But when you ask him to guarantee performance in your shop after the machine is in the hands of your men, it's another story, unless you also specify conditions of materials, tools and coolants, as well as the skill and good intentions of your men. When the fault lies with the machine itself and is not due to things which happen in your plant, he's guilty and ought to be glad to make it right."

"But he furnishes the tools so they ought to be O.K., Tom."

"They probably are, when he turns the machine over to you. They may be damaged at the first grinding or they may be replaced by poorer material and with incorrect cutting angles. The machine may be neglected both as to lubrication and coolant supply. Few workmen will admit being at fault. Most of us try to find an alibi when things go wrong. Lack of production due to carelessness or to insufficient training will usually be laid to the machine if possible."

"But the foreman must know when it's the man's fault, Tom."

"He probably does. But he'll also probably back up the man so you won't think the failure is a reflection on his ability as a boss. He wants you to think his eagle eye is on the job every minute. I remember one foreman who believed in big glass oil cups on his machines. He had covered the machines till they looked like Christmas trees. Said he could see at a glance when men didn't keep 'em filled as they should. Then he took me out to prove it. He was right. Nearly every one was empty—and was he sore?"

"Any other reasons, Tom?"

"Yes, when a machine has been bought contrary to the foreman's suggestion he may consider it a reflection on his judgment. I know one case where the machine failed from lack of lubrication. The foreman knew it and so did the maker's service men who repaired it. They reported it to their office, of course. But the builders felt it to be cheaper to shoulder all the cost of repairs and travel rather than go to bat with this foreman, who had a drag when it came to placing orders for new machinery."

"Well, Tom, what about rejects? The machine ought to turn out good work."

"Sure—and it probably will if it gets a chance. But rejects may be due to the tools, to the wear of inspection gages or to inspection methods. Some force a snap gage over a piece and re-

The big oil cups showed clearly enough that the machine had not been oiled

ject it as small if it goes over easily. Others want the gage to go over by its own weight and call anything else large. Tools improperly ground may cause rejects, as may dull drills or taps or dies. I've known a change in coolant to make a difference in the diameter of a piece of work on a screw machine."

"If I didn't know better, Tom, I'd think you were building machine tools and trying to prove an alibi when they were below par. I don't quite see how all the things you mention are likely to happen in our shop."

"They probably won't, Bill. But if they did and you had the machine builder sewed up with a lot of guarantees he might have to fold up and call in the sheriff. I want to see you get the best machines built just as I mean to when I buy for my own shop. You've got to have guarantees. But make them reasonable and allow for contingencies that are not in any way the fault of the builder. If he tries to short-change you, soak him plenty. But don't make it possible for his machine to be framed in your shop, intentionally or otherwise."

"That's a new one, Tom. Just how can you 'frame' a machine?"

"It's been done lots of times, Bill. Sometimes it's the operator, sometimes the foreman. Sometimes it's a personal grouch because you didn't buy the machine he wanted. Once in a while an over-ambitious salesman for a rival machine splits a commission with the framer, if he gets an order. If the operator or the foreman doesn't like a machine, it has a hard row to hoe in any shop. If both are 'again' it, it hasn't got a prayer of a chance."

"But you've got to decide what machine is best for the work. You can't have your men pick it out for you. You're the one that's responsible. They've got to like what you buy."

"True, Bill. But sugar gets more flies than vinegar. Many shop managers find it pays to *sell* the new machine to the men before it goes into the shop. One very successful super I know sends his foreman and the operator to see the machine at work in a nearby shop. He paves the way by pointing out some of its good features. They usually sell themselves on the machine and think they helped to pick it. When they feel it's partly their baby, it's got to work—and it usually does.

"Make your guarantees reasonable, Bill. How would you like to guarantee making nine bull's eyes out of ten at target practice? There are so many things that may make it impossible to guarantee perfection that you'd hesitate a lot, I know. Put yourself in the builder's place and let your conscience be your guide."

Why a Time Study?—Discussion

JAMES PRESTON

Referring to the article by P. Kornau under the title given above (*AM*—Vol. 78, page 511), time and motion studies are not merely devices to secure a blanket labor rating over an entire cycle of movements, but to ascertain the degree of efficiency being realized in the use of money invested in equipment, tools, labor and material. To secure such a rating, it is necessary that the unit of expenditure be broken down into the various elements entering into the total cost. This can be done only by an experienced observer who is capable of noting, segregating and tabulating unprofitable factors in the various elements, with their elimination in view.

Of the inanimate elements, such as machines, tools and materials, the observer needs to be a first-class mechanic knowing speeds, feeds and capacities combined with a knowledge of tool design. In his study of the human element, he should be something of a psychologist and a diplomat, knowing human reactions and able to secure the confidence of the operator. No grinding down of labor is anticipated in true time and motion studies. On the contrary, their object is to give the operator the benefit of up-to-date mechanical aids, to advise him of the most effective methods and to set a labor award consistent with the degree of efficiency shown by him in his use of these methods and mechanical aids.

After the studies have been completed, it should be possible for any analyst to set down detailed standard instructions for future guidance, not only for the particular job studied, but for all work of a like nature. Tables and charts compiled from such studies are extremely valuable to the plant management for capacity-control purposes, for setting delivery dates, and to the sales department in bidding for new work.

Taken by and large, money spent in true time and motion studies made by competent observers is probably one of the most profitable investments that any enterprise can make, and labor award set on this basis is far more just as a whole than hit-and-miss or personal-favor methods of the average shop management. It is true that individuals react differently while under observation. Some work feverishly, some are extremely nervous, some remain in full control of their emotions and work normally, while others give a good imitation of a slow-motion picture in an attempt to fool the observer. It is in dealing with the human element that the observer will show his greatest value to both men and management by his skill in reading humanity.

No doubt there are places where time and motion studies are a farce. Under such conditions the results are naturally dangerous to both the life of the enterprise and the pay envelope of the worker. Like any other class of labor, there are some men attempting time and motion studies who would be of greater value in some other kind of work. Nevertheless, time and motion studies, regardless as to whether the payment is by piecework, day work or premium, are the most equitable bases for rate setting and will most likely remain as principle guides in progressive industry.

Sharp Corners

It has long been known that notches, oil holes, grooves, tool marks and corrosion pits in machinery parts produce abrupt changes of section with consequent stress concentration and have been responsible for many failures. However, a study of this subject by Dr. D. J. McAdam, Jr., chief of the optical section, the National Bureau of Standards, has resulted in some quantitative data. The Bureau's work has demonstrated that the damaging effect of corrosion pits and other notches increases with the hardness or strength of a given metal. Thus the corrosion time required to cause serious loss of resistance to repeated stress is much less for high-strength than for low-strength steels. For example, 15 per cent damage was produced in low-strength steel in 60 days, while less than one day was required to damage a spring steel to the same extent.

The damaging effect of a notch differs greatly for metals of different types. The effect of a notch on copper, Dr. McAdam found, is greater than the effect on steel of the same strength. The relationship between notch sensitivity and various other properties of metals such as work-hardening capacity has also been studied. Because the presence of a sharp notch may counterbalance any advantage of superior strength, in many cases, effort spent in producing high strength materials may be wasted.

• IDEAS •
FROM PRACTICAL MEN

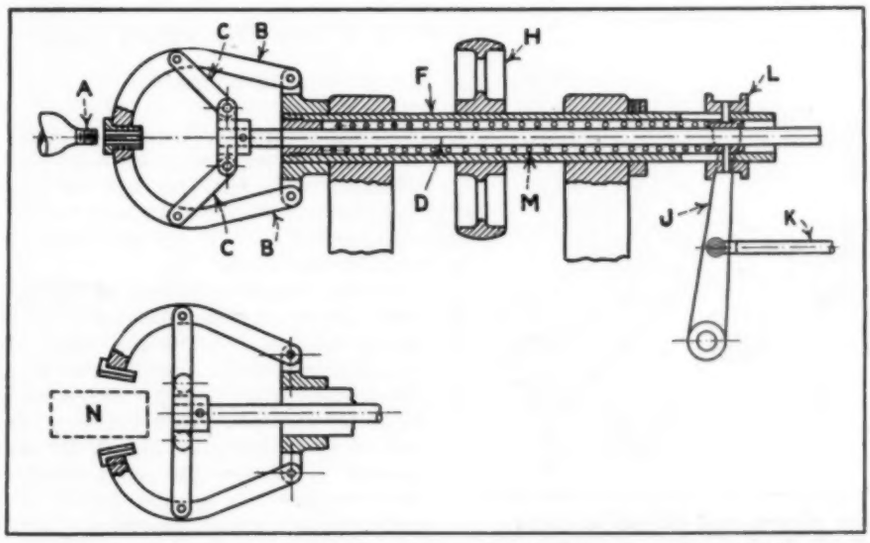
Mechanism for Closing the Wrappings of Packages

F. H. MAYOH

A device for twisting the open end of foil, as at *A*, to close it on a package wrapped in it is shown in the illustration. The twisting action is accomplished by rotating the unit while the package is stationary.

Jaws at the ends of arms *B* are opened and closed by links *C* through longitudinal movement of rod *D* in the hollow shaft *F*. The unit is operated to twist the foil by revolving it by pulley *H*, which is intermittently driven by a belt from the machine. The movement of rod *D* is controlled by lever *J*, which is operated by the cam-operated rod *K*. At the upper end of lever *J* is a yoke engaging the flanged collar *L*, which collar is connected to rod *D* by a pin passing through a lengthwise slot in the hollow shaft *F*. As lever *J* moves the flanged collar to the left, the movement is transmitted to rod *D* and through it to links *C*, opening the jaws as shown in the small view in the lower left-hand corner of the illustration. At the same time, spring *M* is compressed.

The open jaws permit a mechanism indicated at *N* to enter sidewise and remove the package. Another package is fed to the jaws by a mechanism (not shown). As soon as the cam lobe passes the roller on the right-hand end of rod *K*, spring *M* moves collar *L* to the right, which movement is transmitted to rod *D*, closing the jaws by the action of links *C*. The unit is then rotated and the jaws twist the open end of the foil and close the package.



Packages wrapped in foil, but with one end open, are automatically fed to this device, the jaws of which close them by twisting the foil

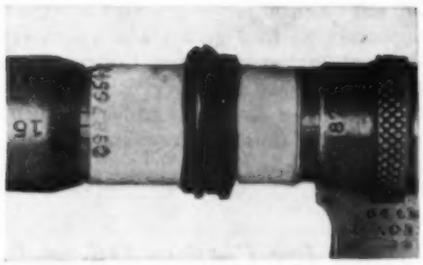
Wanted—A New Diamond-Pointed Angle Tool

Here is a question for the writers of contributions to this department to answer. A friend tells us that he wants a new design of angle tool which permits the insertion of a diamond nib at any desired angle, and the turning of the diamond to any angle. The editors believe this question to be worth putting before readers of this department.

An Aid in Reading Micrometer Verniers

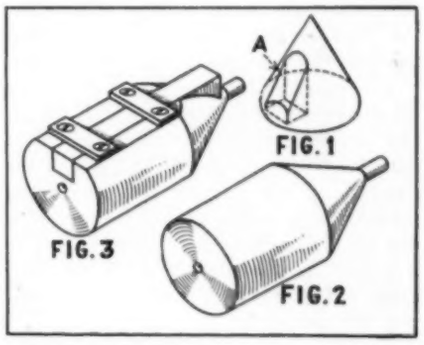
N. M. MOORE
Hamilton, Ontario, Can.

In reading the vernier of a micrometer graduated to 0.0001 in., it is difficult to read the figures connecting the lines quickly, especially when the micrometer is opened ½ in. or more. In connecting the lines with the figures, it is necessary to run the eye up and down the lines several times, because, with long lines so close together, the eye is likely to become confused and wander from one line to the next and so mistake the reading.



With the vernier figures marked on white paper secured to the barrel, there will be no difficulty in reading the vernier quickly and correctly

The difficulty was obviated by wrapping a piece of white paper around the barrel, securing it with a rubber band, and penciling the figures on the end next to the thimble, as indicated in the illustration. If the end of the paper on which the figures are marked is kept close to the thimble, there will be no difficulty in reading the vernier quickly and correctly.



The point of a toolbit of high-speed steel was ground on one side to a section of a cone

Grinding a Section of a Cone

J. E. MOORE

A professor from the university wanted us to make him a special tool for the science department. The tool was to be made of high-speed steel and to have a point of the shape *A*, Fig. 1, such as would be obtained if a ½ square section were cut from a cone.

A piece of cold-rolled shafting was turned as in Fig. 2. A ½-in. groove was then milled parallel with the axis of the cone and the upper surface was flattened by milling until the groove was a scant ½ in. deep. Four holes were drilled and tapped for screws for clamps and a ½-in. square high-speed steel tool-

bit was clamped in the groove, the whole appearing as in Fig. 3. The assembly was put in the lathe and the point of the toolbit was ground even with the cone, using a toolpost grinder. When the tool was finished, the point was the desired shape.

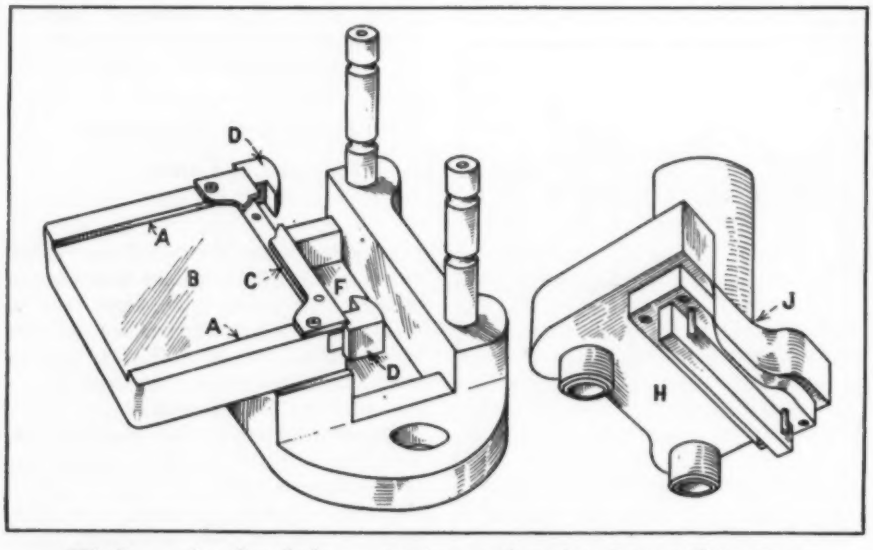
Tools for Cutting Off and Piercing Viscoloid Strips

CHARLES H. WILLEY

In a small shop forced to compete with larger and more modern plants for a share of business, satisfactory tools that are inexpensive are an important problem. One such set of pillar tools is illustrated and is used for making the many thousand window strips of viscoloid for the dash ammeters of Ford cars. The tools pierce two holes and cut off the strips at each stroke of the press.

The stock is fed into the tools between the guides *A* on the platen *B*, under the stripper *C* and against the stops *D*. The first piece is cut off without being pierced, but the stock for the second piece is pierced before it is cut off, and a finished piece is produced at each stroke of the press after the first. The finished pieces drop through the opening *F* and into a box.

The punches for piercing and cutting off are mounted in the punch-holder *H*, the concave section *J* being for clearance for the operator's fingers, which are stopped by the stripper *C*. Additional precaution is taken having the operator use an ordinary rubber-tipped pencil as a pusher as the strip of stock becomes short. The piecework rate is one cent per 200 pieces.



Window strips for dash ammeters are pierced and cut off in these pillar tools at a rapid rate. The finished pieces drop through an opening in the bolster

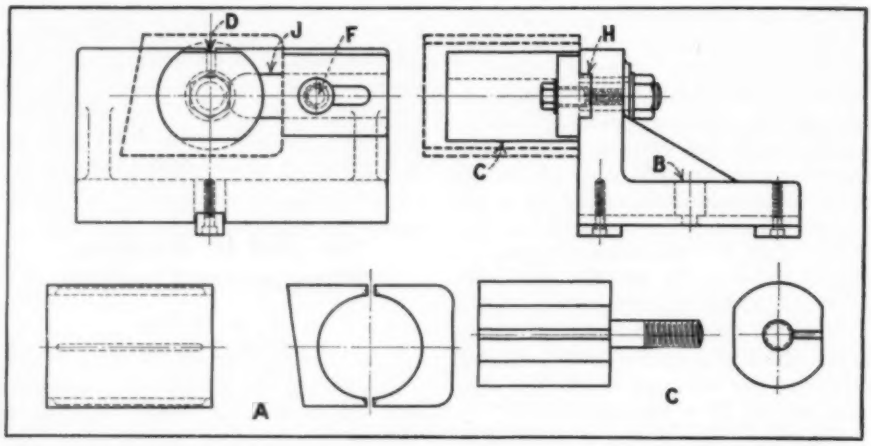
Simple Fixture for Splitting Bearing Blocks Discussion

CHARLES C. TOMNEY
Chief Tool Designer,
Carrier Engineering Corporation

On reading the article by F. Server under the title given above (*AM*—Vol. 78, page 422), I was reminded of the method we use for splitting bearing blocks of various sizes. The blocks *A* are made of comparatively soft metal and are so thin at the places where they are cut that they do not have to be clamped in the fixture.

The base of the fixture has a short tongue at each end to fit the slot in the machine table and is attached to the table by a bolt through the hole *B*. The vertical part is bored and reamed for the shank of the stud *C*, the work being located on the stud, which is flattened at both top and bottom and has a slot at *D* for saw clearance and for setting the saw central. Interchangeable studs are provided for holding bearing blocks of various sizes. The flat at the top of the stud is for clearance for the burrs thrown up in sawing, and the flat at the bottom is to clear these burrs when the bearing blocks are turned around for the second cut.

In order to square up the bearing block, the adjustable plate *F* is so set that the edge of the block just clears it by a few thousandths of an inch. The plate has a tongue at *H* to engage the slot *J* and is held in place by a capscrew. Before being sawed, the bearing block is stamped on each side with the same number so that the mating halves can be identified. After the saw has made the cut at the top, the bearing block is removed from the stud and is replaced bottom side up. Then the final cut is made, splitting it in two.



Bearing blocks are mounted on a stud and are located by an adjustable plate. No clamping is necessary as the comparatively soft metal is thin where the cuts are made

A Three-Direction Cam

HENRY CHESTER

It was desired to increase the speed of a machine and reduce its noise and vibration. The machine has an arm that works forward, down and to the right, and then left, up and back to complete the cycle.

In the former machine, of foreign make, some of the movements were spring actuated, and as the speed of operation was at the rate of 1500 r.p.m. the machine made a clatter comparable to an air hammer. With the three direction cam shown in Fig. 2, it was possible to increase the speed twenty-five per cent and greatly reduce the noise. The various movements were smooth and continuous and spring breakage was eliminated. Details, in-

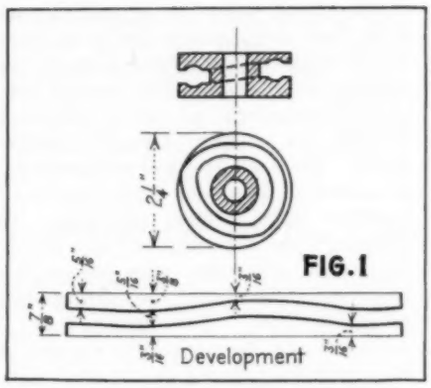


FIG. 1

Fig. 1—Development of the cam and section showing its radial movement. Fig. 3—Plan view of lathe that makes clear how the weighted cables control movement of the work in both directions

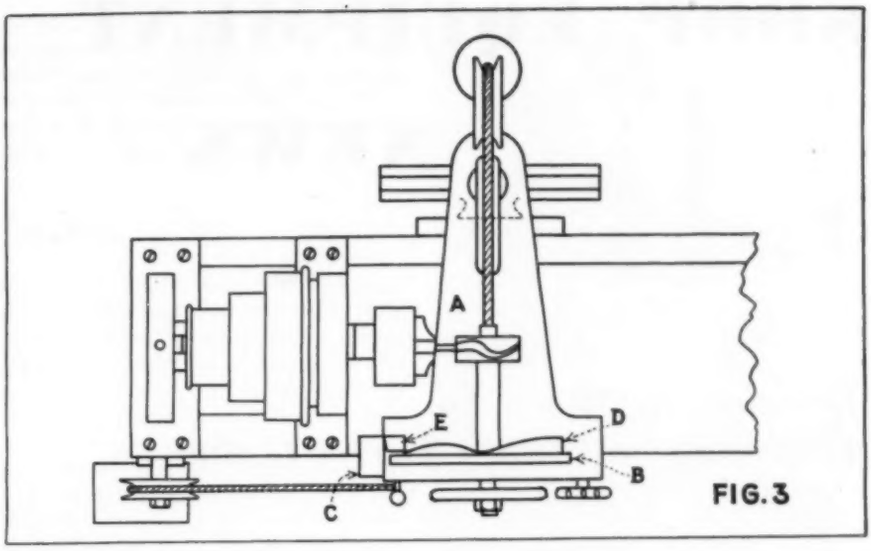


FIG. 3

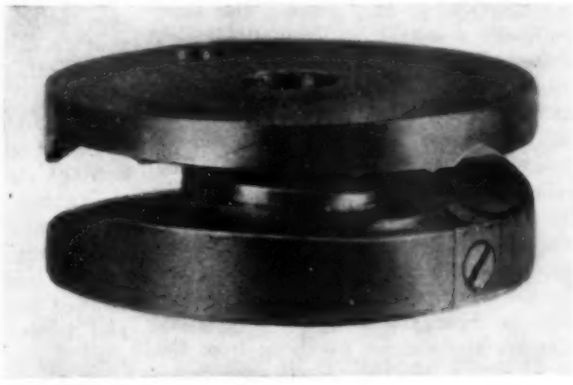


Fig. 2—Completed cam showing the block inserted to fill the opening for entering the cutter and maintain a continuous surface on the working side

cluding a development of the path of the cam, are shown in Fig. 1.

The cam was cut on a bench lathe, using a master edge and face cam. A plan view of the layout is seen in Fig. 3. The first operation in cutting was to use an end mill and cut the right and left path to a predetermined depth and concentric with the center of the cam. The next operation used a cherrying or spherical cutter and machined the up-and-down, and forward-and-back groove. The path for the up-and-down, and forward-and-back movements is machined for a spherical roll. This roll is made of non-ferrous material in the shape of two hemispheres, with a spring washer between the two halves. This method of roll construction reduces friction and contributes to silent operation of the machine.

Referring again to Fig. 3 which shows the way in which this cam was cut, it will be seen that the movement of the cam support *A* is kept in contact with a master cam by weighted cables that control both longitudinal and fore and aft movements. The in-and-out movement of the cutter is controlled by a periphery cam *B* acting against the stop *C*, while the curved cam path depends on the face cam *D* and the stop *E*. Though simple, this method enabled duplicate cams to be cut in reasonable time.

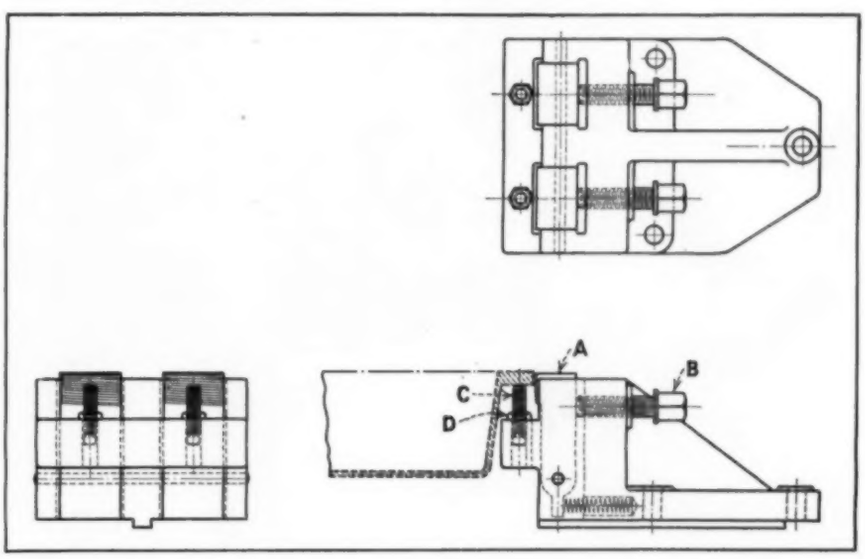
Gripping Jaws for Milling Machines and Planers

C. W. PUTNAM

The illustration shows one of two pairs of jaws for the milling machine or the planer. The other pair is a duplicate. The purpose of these jaws is to hold work similar to that indicated in heavy dotted lines, as well as slab castings.

The base carrying the jaws is in the form of an angle plate and is provided with a tongue to fit the slot in the machine table. The pivoted jaws *A* are tool steel, serrated, hardened and then ground to fit pockets machined in the base. They are operated by the binding screws *B* and are released from the work by springs when the binding screws are slackened. At *C* are leveling screws having square heads fitting freely in square holes cored in a projection of the base to prevent them from turning when the nuts *D* are adjusted.

The jaws are forced against the work by screws and are released by springs when the screws are slackened. Screws for leveling the work are provided



SHOP EQUIPMENT NEWS

Bardons & Oliver No. 3 Universal and Plain Turret Lathes

Bardons & Oliver, Cleveland, Ohio, are now offering No. 3 Universal and Plain Turret Lathes with a bar capacity of 1½ in., and swing of 15⅜ in. The plain turret lathe differs from the universal lathe only in that it is not equipped with power cross and longitudinal feed to the carriage.

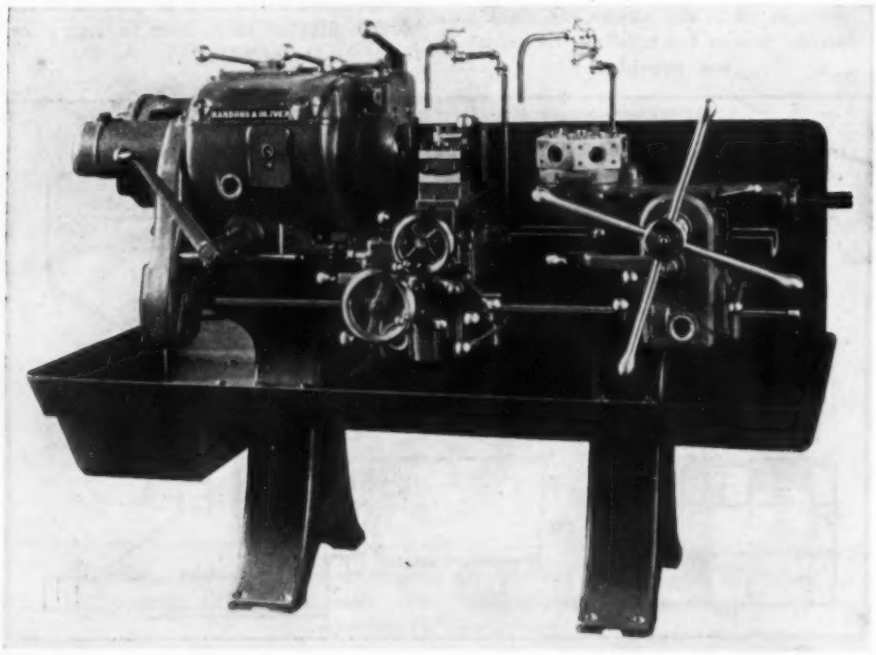
These lathes can be had with either a 12-speed or an 8-speed all geared head. The 12-speed head provides a speed range from 67 to 1,015 r.p.m. when using a 1,200 r.p.m. motor, and from 100 to 1,525 r.p.m. when using an 1,800 r.p.m. motor. The 8-speed head provides a speed range from 75 to 1,015 r.p.m., when a 1,200 r.p.m. motor is employed, and from 113 to 1,525 r.p.m. when an 1,800 r.p.m. motor is used. By mounting the spindle and shafts on antifriction bearings and employing helical gear teeth on the higher speed gears, a quiet, free-running head at high speed is assured. In addition to the double multiple disk clutch conventionally used for start, stop, and reverse, the head embodies a second double multiple disk clutch through which an instantaneous speed reduction of 2 to 1 may be obtained for threading, reaming and similar operations. Sliding gears furnish all other speed changes. Positive forced feed oiling is delivered to the front and rear spindle bearings and, through hollow shafts, to both multiple disk clutches from a constant speed pump inside the head. The spindle end of flanged type affords rigid mounting for chucks or fixtures and reduces overhang from the front spindle bearing. A standard flange type ball bearing motor is bolted directly to the end of the head, and the rotor is pressed on the first drive shaft.

The universal carriage has power longitudinal feed as well as power cross feed, making it possible to do turning and boring as well as facing and forming with tools mounted on the cross slide. Six reversible power feed changes to the carriage and cross slide are obtainable independently of the turret feeds through the carriage apron by shifter levers. Feeds are engaged or disengaged by means of knock-out levers and cam-operated cone friction clutches. An indexing stop cylinder, carrying six independent adjustable stop screws, automatically disengages the carriage longitudinal feed. The cross feed is automatically disengaged by means of an adjustable trip dog on the cross slide. When taking facing cuts the carriage can be clamped to the bed by a single lever, and when taking turning cuts the cross slide screw can be locked by means of a binder screw.

Automatic indexing of the square turret is performed by the same handle that clamps it to its seat. An open-side toolpost, having serrated wedges to provide height adjustment for the cutter, is attached to the rear of the cross slide.

The saddle is of patented cantilever construction to permit the cross-slide carriage to pass partly underneath, giving the turret slide a long bearing in the saddle and reducing overhang. The turret revolves on a tapered roller bearing and is automatically released, indexed and clamped by the backward and forward movements of the turret slide. Six visible independent stop screws are carried in a stop cylinder which indexes automatically with the turret. These screws may be adjusted to disengage the power feed at any desired point for each of the six turret faces. Six power feed changes to the hexagon turret are obtained through the saddle apron gearbox independently from the carriage. The saddle apron is completely inclosed for flood lubrication.

The automatic chuck and bar feed are both operated by a single lever under the front of the head. Forward movement of the lever opens the collet and feeds out the bar, while the backward movement closes the collet. The collet grip has been increased to withstand the heavier feeds of which the machine is capable.



"Sta-Put" Extreme-Pressure Gear Oils

E. F. Houghton & Co., Philadelphia, Pa., has added to its line of "Sta-Put" oils a series of lubricants designed to meet extreme-pressure gear lubrication problems. This viscous oil series covers all the requirements from that of light-duty speed reducers to the heaviest of worm- or herringbone-type speed reduc-

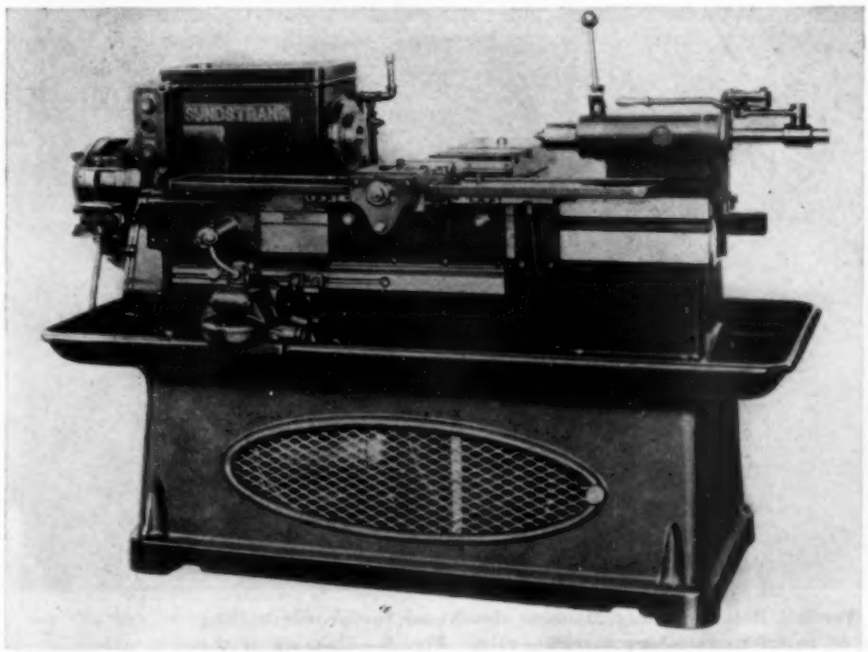
ers operating under shock loads. The company states that tests on standard measuring machines show that "Sta-Put" 600-series extreme-pressure gear lubricants are capable of withstanding from three to five times the load that straight mineral oils of the same type are capable of doing. It is further stated that the actual torque readings show that the lubricants will carry these loads with reduced frictional losses of as much as 30 to 50 per cent.

Sundstrand 6-In. Stub Lathes

Semi-automatic and automatic 6-in. Stub lathes are being built, each in three models, by the Sundstrand Machine Tool Co., Rockford, Ill. The three models are as follows: Model A—Has a chain drive from motor to speed box; gear drive to spindle, the spindle speed range being from 62 to 663 r.p.m.; Model B—has a chain drive from motor to speed box; gear drive, including a non-metallic idler, to spindle; spindle speed range from 192 to 1790 r.p.m.; Model C—has a flat belt drive direct from motor to spindle, spindle speed range from 1,000 to 3,500 r.p.m. Motor pulley has a taper hole which fits a tapered bushing on the motor shaft. This construction makes it easy to change motor pulleys in two or three minutes.

Besides the speed ranges given above, specifications are as follows: Capacity between spindle nose and tailcenter, 16¾ in.; swing over bed ways, 17 in. in diameter; swing over front and rear tool slide ways, 7½ in. diameter; hole through spindle, 1$\frac{13}{16}$ in.; front carriage feeds, Models A and B, 0.003 to 0.086 in.; front carriage feeds, Model C, 0.0015 to 0.042 in.

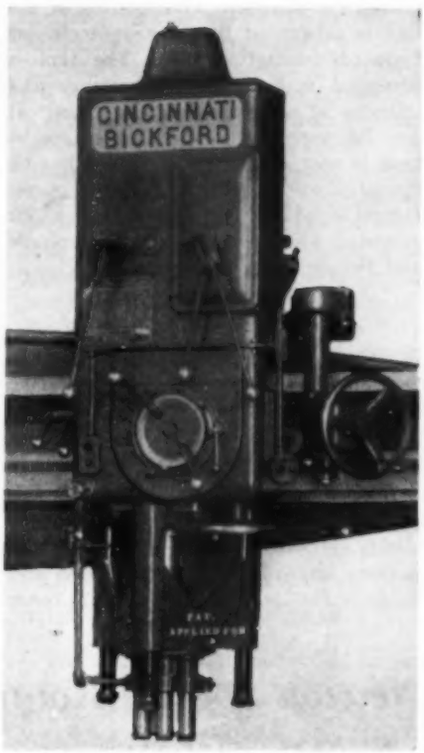
An adjustable control stops the spindle before completion of the rapid return. The live tailcenter is equipped with ball bearings and the tailstock is equipped with a quick-acting clamp. The tailstock itself is of the quick-acting lever-operated type. An improved mechanism provides accurate and reliable automatic engagement and disengagement of feed and complete control of the operating cycle on the automatic machine. Pick-off gears for the spindle speed changes are fully inclosed, but readily accessible. Set-up of the automatic machine is facilitated by hand adjustment for the carriages. A separate motor drives the rapid traverses on the automatic machine. The rear slides are made in light and heavy duty types. Pick-off gears for the feed changes are fully inclosed but readily accessible.



Sundstrand 6-In. Stub Lathe of standard design

Multiple-Spindle Drillheads for "Super Service" Radial Drills

The Cincinnati Bickford Tool Co., Oakley, Cincinnati, Ohio, has patented a self-counterbalancing mounting bracket for multiple-spindle drillheads to be used on its "Super Service" radial drills. The bracket compensates for the weight of the drillhead, and the head and mounting bracket may be removed in a few minutes so that the machine can be used for other work. The illustration shows a 6 ft. radial drill equipped with a fixed-center, ball-bearing drillhead to carry three, 1¼-in. drills, spaced on 2¾ in. centers, each spindle having vertical adjustment. Another mounting is of the swivel type, not illustrated, to permit rotary adjustment of the drillhead.

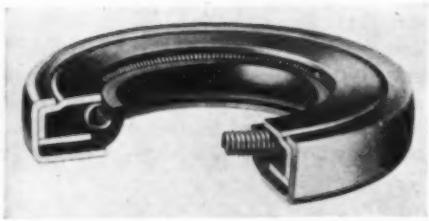


Either type of drillhead has the spindles in line, but other types of drillheads are equally applicable. Bolt-circle drilling of several diameters is being handled with an adjustable-center-distance drillhead.

Dumore No. 9 Hand Grinder

The Dumore Co., Racine, Wis., offers the No. 9 hand grinder for production grinding of large and small dies and molds, and for the cleaning up of weld spots. Although the motor develops ⅛ hp., the tool weighs only 7 lb. A feature is an air filter which keeps out the grinding dust. This filter is inclosed in the end cap and can be re-

moved for cleaning. Overheating of the tool is prevented by a vacuum cleaner type of ventilating fan. The tool is equipped with three ball bearings and operates at a speed of 14,250 r.p.m. It can be supplied with either a spade-type handle, as shown, or with a handle mounted on the side. The tool comes complete with wheel arbor, chuck for mounted wheels, small extension spindle and two grinding wheels.

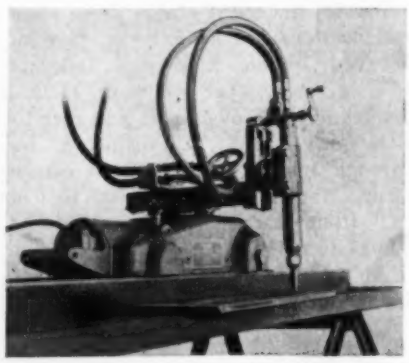


National Type BB Oil and Grease Seal

The National Motor Bearing Co., 1197—78th Ave., Oakland, Calif., has developed a Type BB oil and grease seal which is claimed to exclude completely extraneous matter and to provide positive imprisonment of oil, grease and fluids. The seal consists of an outer seal case that locks the seal assembly and which has a press-fit of ±0.002 in. on the diameter. An equalizing annular garter spring within the case provides a uniform continuous contact of the sealing member at all points circumferentially. The actual sealing member is made of various materials, usually a processed leather, to suit different conditions such as temperature, peripheral speeds, unbalanced pressures and chemical activity. A catalog describing the seal and showing applications has been published.

Oxweld CM-8 Cutting Machine

The Linde Air Products Co., 30 E. 42nd St., New York, N. Y., has added the "Monitor" CM-8 cutting machine which does automatic straight-line cutting of practically unlimited length, straight bevel cutting, two bevels at a time if desired, plate edge preparation, circle or ring cutting of diameters up to 100 in., and the cutting of curved or irregular shapes. The machine is easily portable. One blowpipe, the Oxweld C-7, permits cuts up to 12 in. The Oxweld C-22 blowpipe may be substituted for heavier cutting, and certain flame-machining operations. Provision is made for the use of two blowpipes simultaneously. These can be mounted either on the same or opposite sides of the machine and adjusted independently. The slide for the blowpipe holders is constructed so that it may be swung into any horizontal position over a working arc of 250 deg. Protractor scales gage the tilting of the blowpipes in either direction parallel to the side of the machine through 90 deg., and to 90 deg. at right angles to the side.



Newton Special Rotary Milling Machine

The Consolidated Machine Tool Corporation of America, Rochester, N. Y., recently built a special "Newton" rotary milling machine for profile milling the various surfaces around the outside of square or rectangular castings having rounded corners. The particular machine illustrated was equipped for milling two beads around the outside of aluminum washing machine tubs. It has two opposed vertical spindles, which in the case of the job shown carry concave milling cutters for profile milling the two continuous beads. These vertical spindles are mounted in Timken bearings, the upper spindle being adjustable by an eccentric sleeve to compensate for cutter grinding.

The rotary table is equipped with a special fixture for holding the castings. This rotary table is provided with a circular feed and is mounted on a reciprocating slide. Loading and unloading the castings is accomplished by traversing the table to the limit position nearest the operator. As soon as the casting is loaded and clamped the release lever starts a complete cycle in which the two beads are milled in one revolution of the table.

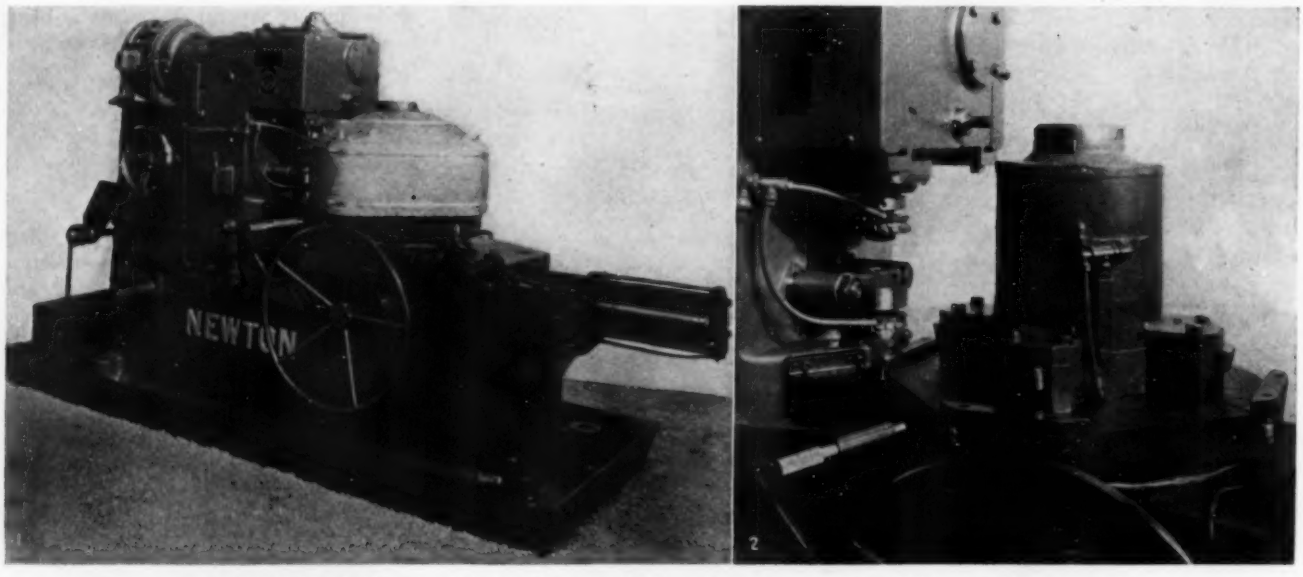


Fig. 1—Special Newton Vertical Rotary Milling Machine developed for profile milling two beads on the outside of aluminum washing machine tubs. Fig. 2—Close-up of the special fixture for holding the castings. The table is mounted on a reciprocating slide

Williams, White Universal Tube Bending Machine

Four sizes of a universal tube bending machine are being built by the Williams, White & Co., Moline, Ill. The No. 1¼ U will bend up to and including 1¼ in. tubing, ⅛ in. wall, 6 in. radius; No. 2-U, up to 2 in. tubing, ⅛ in. wall, 8 in. radius; No. 3-U, up to 3 in. tubing, ¼ in. wall, 12 in. radius, and No. 4-U, up to 4 in. tubing, ¼ in. wall, 24 in. radius.

Features of these machines are as follows: All moving parts are hydraulically driven through racks and pinions; the clamp is of the toggle type; tubes are unloaded after bending without the operator touching the dies; either right-hand or left-hand bends can be made; table is dropped in front so that short bends can hang down, making it unnecessary to change the machine from right- to left-hand for many jobs; the cross clamp holds the same way for either right- or left-hand bends; bending pressure is applied directly to the cast steel swinging arm and not to the shaft supporting the die; an adjustable automatic stop and graduated table front cuts the set-up time; the rear of the table is graduated to simplify the setting of the arbor pull cylinder for changes in radius; the bending dies work either right- or left-hand, by turning them over right to left, and if it is desired to pull the mandrel through the tube instead of the tube off the mandrel, the die is turned over front to back.

The swinging arm or tube puller is cast steel and fitted with a toggle-operated clamping device as shown in Fig. 2. The swinging arm extends through the table, and the main drive gear is attached to the lower end. Passing through the swinging arm is a steel shaft with an enlarged top for supporting the die. A jaw clutch attached to this shaft holds the die in position for bending and is thrown out for unloading. The swinging arm gear is driven by a rack attached to the main cylinder.

A cross clamping device is located on the top of the table. It is operated by a rack and pinion attached to a double-acting hydraulic cylinder that holds either for right- or left-hand bending. Notches across the top of the clamping device permit adjustment of the rollers that back up the sliding die. A T-slot across the rear end of the table supports the arbor-operating cylinder and the sliding-die cable pull-back. The table is graduated on the top to simplify setting this cylinder for changes in radius. The cylinder is double acting to push the arbor into the tube before bending and to pull it out after the bend is made.

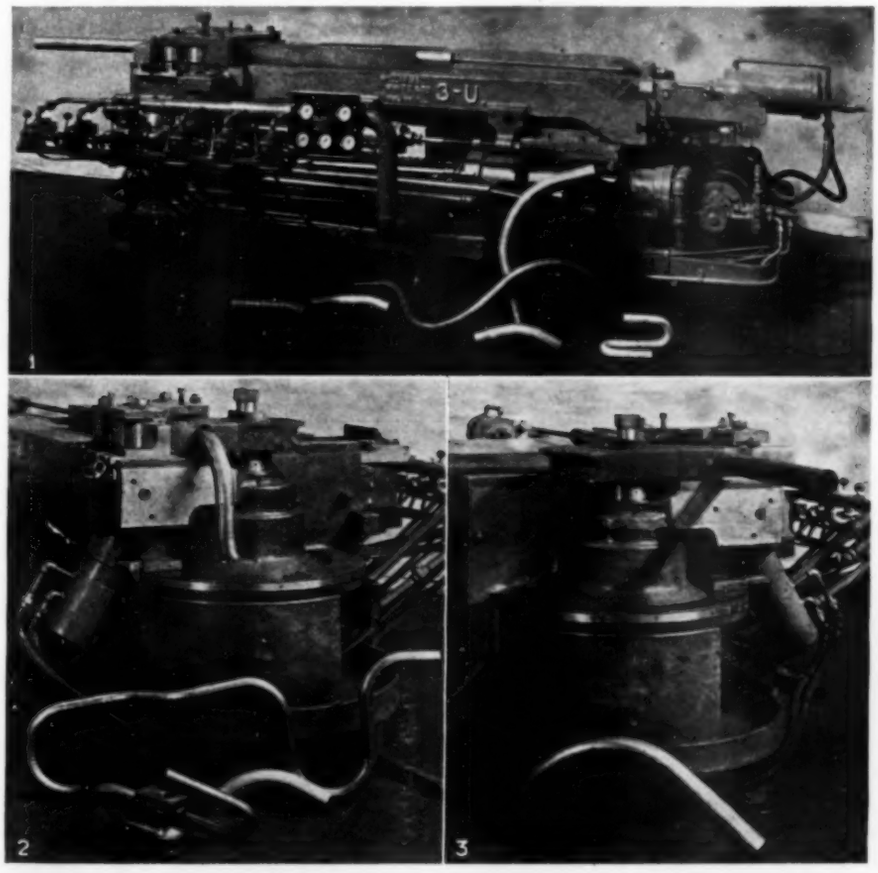
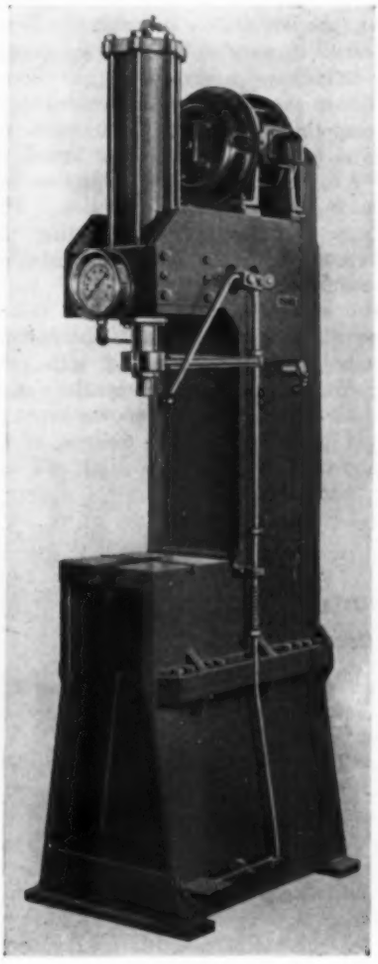


Fig. 1—At the right is the hydraulic arbor-operating cylinder that is adjustable in the T-slot for changing the radius of bending. Fig. 2—The cylinder mounted at an angle operates the toggle clamping device for the swinging arm. The cross clamp is actuated by a rack and pinion at the opposite side. Fig. 3—In this view the swinging arm is shown as having moved through 180 deg.

"Logan" Hydraulic Forcing and Broaching Press

The Logansport Machine Co., Logansport, Ind., is now producing a line of welded-steel hydraulic forcing and broaching presses, in capacities from ½ to 50 tons. The oil reservoir is in the column, and the oil pump and valves



are mounted on a panel, attached to the column. The pump is chain driven by a motor mounted on top of the press. The hydraulic control valve is either foot or hand operated. Automatic or manual reverse of the ram is provided, and reverse can be made at any point of the down stroke. When the ram reaches the top position the pump by-passes and does not work against the pressure. A stop rod is arranged on the side of the press for regulating the length of the down travel and the stop position of the ram at top stroke.

Tables of various heights and designs can be furnished to suit special requirements. Hydraulic or air-operated work-holding fixtures can be designed.

"Racine" Variable-Volume Hydraulic Pump

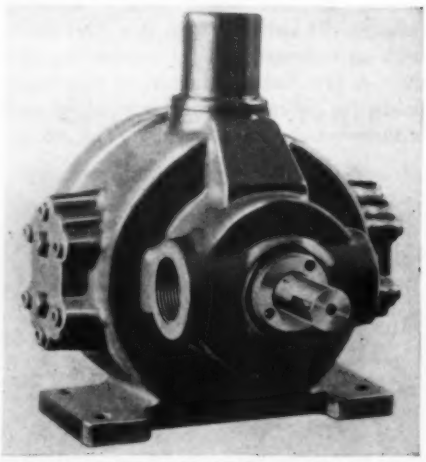
The Racine Tool & Machine Co., Racine, Wis., is marketing a variable-volume hydraulic pump which will deliver pressures to 500 lb. per sq. in. and momentary pressures up to 1,000 lb. per sq. in. This pump is available in three sizes, with volume ranges to 2,000, 4,000 and 6,000 cubic in. per min. These sizes are all furnished in one size of pump case, the variations in capacity being obtained by varying the width of pumping rotor.

Pumps are the multiple-vane type, having thirteen vanes, which when revolved at a constant motor speed of 1,200 r.p.m. provide 15,600 impulses per min. to insure smooth operation. The volume is controlled by offsetting the governor ring or pumping chamber mechanically or automatically. Automatic control is provided by a piston type of hydraulic governor. This feature eliminates by-passing of oil with consequent reduction in temperature rise, and also reduces the horsepower input in direct proportion of the volume of oil pumped. The pump is small and can be built into machines.

Century Eight-Speed Gear Motor

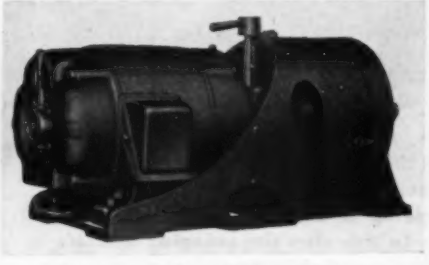
An eight-speed gear motor consisting of a four-speed motor and a two-speed gear unit is being offered by the Century Electric Co., St. Louis, Mo. Two, four and six-speed gear motors are also available. The motor may be wound for either single-, two- or three-phase power. These gear motors make use of a standard, horizontal ball-bearing motor. A resilient coupling is used between the motor and the gear unit.

Lincoln 75-Amp. Welder



"Racine" Variable-Volume Hydraulic Pump

Modine Unit Heater



Century 8-Speed Gear Motor

Lincoln 75-Amp. Welder

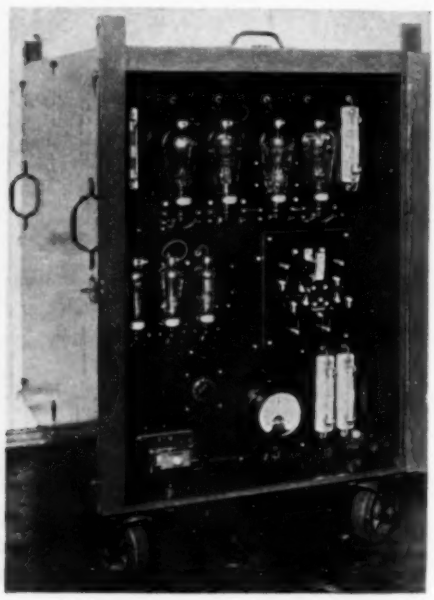
The Lincoln Electric Co., Cleveland, Ohio, can now supply a 75 amp. welder for operations on thin sheets, plates and shapes. Known as the SA 75 this unit will deliver as low as 20 amp. at the arc without the use of auxiliary devices. The supply is a uniform current of proper characteristics for using electrodes as small as $\frac{1}{16}$ in., and thus can be used on materials as light as 24 gage. The welder employs a 25-volt arc with a current range from 20 to 100 amp. Besides operation on 110 volts it can be had for 550 or special voltages, 3, 2 or 1 phase, and 60 or 50 cycles as desired. Floor space is less than 2¼ sq.ft., the dimensions being 20 in. long, 16 in. wide by 40 in. high.

Modine Unit Heater

The Modine Manufacturing Co., Racine, Wis., is now manufacturing a unit heater of the suspended, propeller-fan type. The heater is suspended directly from the steam line and no brackets, pipe rods or straps are required. Sixteen steam and fourteen hot water sizes are being built.

Westinghouse Ignition Welding Timer

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has developed a portable ignition welding timer for use with resistance welding machines. This apparatus will pass electrical current for periods as short as one cycle (1/60 sec.) and is adjustable up to 30 cycles (½



sec.). The dimensions are: 46 in. high, 42 in. long and 29 in. wide. The weight is 700 lb. A unit of this size will carry electrical energy in magnitudes as high as 700 kva., 440 volts, single phase.

Buhr Multiple-Spindle Drilling and Tapping Heads

The Buhr Machine Tool Co., Ann Arbor, Mich., is introducing a line of multiple-spindle drilling and tapping heads furnished now with pre-loaded ball-bearings to prevent vibration of the spindles and to serve as automatic take-up for wear on the bearings. These pre-loaded bearings are also of advantage when the drills break through the holes, since there is no play in individual spindles to increase the feed. The improved adapter *H* is standardized and interchangeable on all Buhr heads and makes it possible to set the head in any desired position horizontally to suit the jig or operator. A steel clamp *J* is used to prevent breakage of the clamping ears when cast integral with the adapter.

The driver *A* is interchangeable on all heads and has a pilot that locates the driver in the head before the key enters. It can be furnished with a key drive on the taper if desired. Idler gears *B* are the stub-tooth type and run on anti-friction bearings, either ball or needle type. Spindles *C* are splined on the gear part of the shaft. They have ground tapers or sockets for adjustable collets. The mounting is furnished in three types: (1) Single-row ball bearing for tapping, reaming and light drilling; (2) Double-row ball bearing for ordinary drilling and boring, (3) for heavy drilling operations where the thrust is larger than the radial load. Tapers in the spindles are ground and the run-out does not exceed 0.0004 in. An improved type of tap chuck *F* has a double key substituted for the pin used in the previous design, and a more balanced drive is obtained.

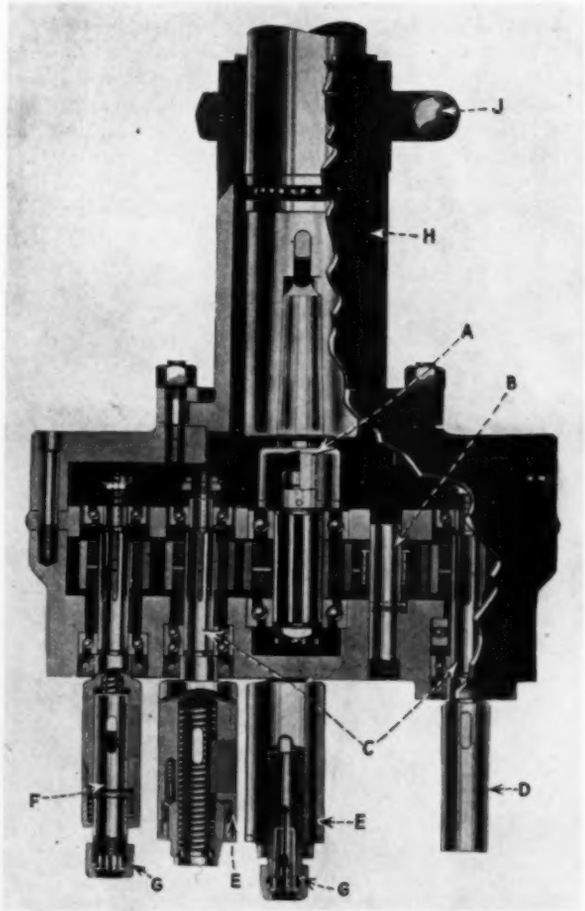
Acme Automatic Precision Nut Tapping Machine

A fully automatic precision nut tapping machine employing straight-shank tapper taps has been developed by the Acme Pattern and Machine Co., 1559 Niagara St., Buffalo, N. Y. This No. 2 machine has a hopper feed of the rotary disk type and employs a 15-in. straight shank tap. The machine is capable of producing threads of all classes of fit, governed only by the accuracy of the tap used. It will tap nuts from $\frac{3}{8}$-24 to $\frac{7}{8}$-14 hexagon, $\frac{3}{8}$-16 to $\frac{3}{4}$-10 hexagon, or $\frac{3}{8}$-16 to $\frac{3}{4}$-10 square.

Production of a threaded nut from the blank is as follows: The nut is helped on by a pusher. A cam of the same lead as the thread actuates the pusher assembly. After the threading operation is completed, the nut drops down and out of the spindle to a stop. This stop releases the nut and permits it to come to rest on the first set of holding jaws, only when the jaws are closed on the tap shank. As the first set opens the nut drops down on the second set of jaws. It is released from the tap and goes down the discharge chute as soon as the second set opens. By this method of tapping, all nuts are tapped in a direct line and each nut while being tapped does not have to force a row of nuts ahead of it.

The tapping spindle is set at a downward 45 deg. angle and uses gravity to expel the tapped nut. Where the grade of steel is likely to cause clogging because of the nature of the chips produced, an auxiliary sweeping device is arranged to insure cleaning of the tap shank.

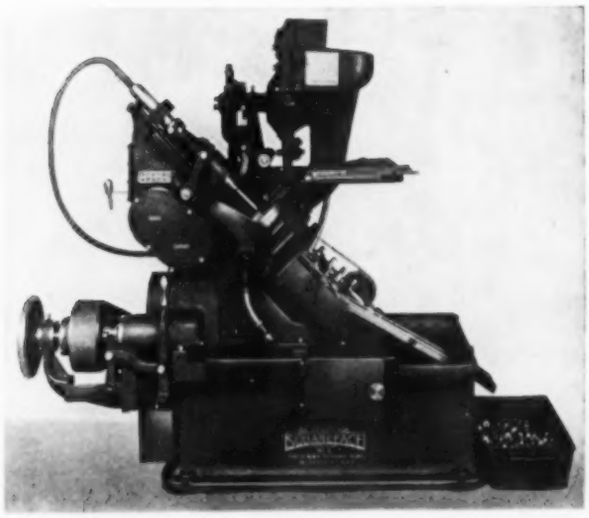
The machine is driven by a single pulley, mounted on a single disk clutch, in conjunction with an automatic throw-out connected to the tapping spindles. As a further protection another throw-out is connected with the tap-holding mechanism. Both safety devices are operated through a solenoid having a connection with the clutch.

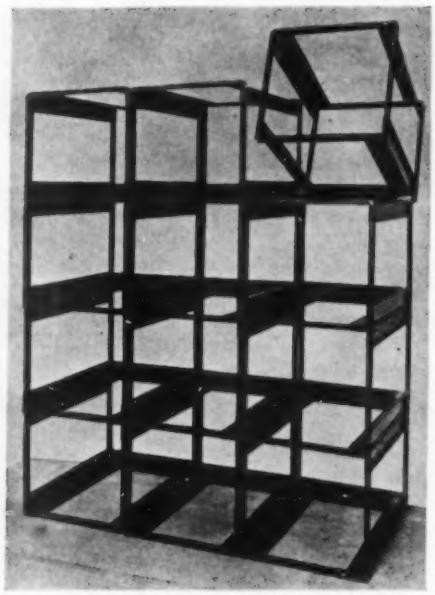


By the use of pre-loaded ball bearings in this Buhr Multiple-Spindle Drilling and Tapping Head vibration of the spindles is eliminated and bearing wear is taken up automatically

"Stackracks" for Stacking Boxes

The Stackbin Corporation, Providence, R. I., is making "Stackracks" to order for the stacking of cardboard,





"Stackrack" for stacking boxes

fiber, wood or steel boxes of any size. This rack can be used under benches, behind machines and in auxiliary stock rooms, and the bottom box is always as accessible as the top one. The "stackrack" is a single unit rack made of channel and angle steel and is finished in olive green enamel.

Kent 3/8-in. Nutting Machine

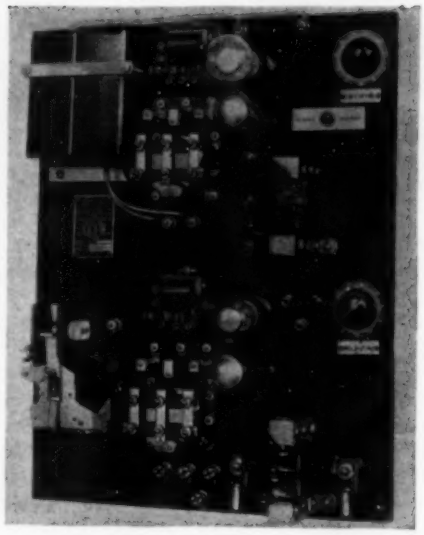
The Kent Machine Company, Cuyahoga Falls, Ohio, is introducing a nutting machine for threading nuts on bolts, screws or other fastenings with diameter 3/8 in. or less. A production of 60 to 70 per cent above that obtained by the common bench spinner is claimed by the manufacturer.

The nuts are fed down two chutes from one common hopper. At the bottom of the chutes the nuts are transferred to rotating heads by specially designed spring actuated plungers controlled by a treadle operated by the machine attendant. The operator takes two bolts and places them in contact with the nuts and the spinning action of the rotating heads threads the nuts on the bolts.

The machine is furnished in belt drive for mounting on the bench or can be furnished with direct-connected motor on a table, as illustrated. This table arrangement provides a portable outfit. The cross bars connecting the legs are the proper height for lift truck transportation. The chutes shown at either side of the table are for holding the bolts to be nutted and these are furnished by manufacturer if desired.

EC&M Automatic Repeat Weld Timer

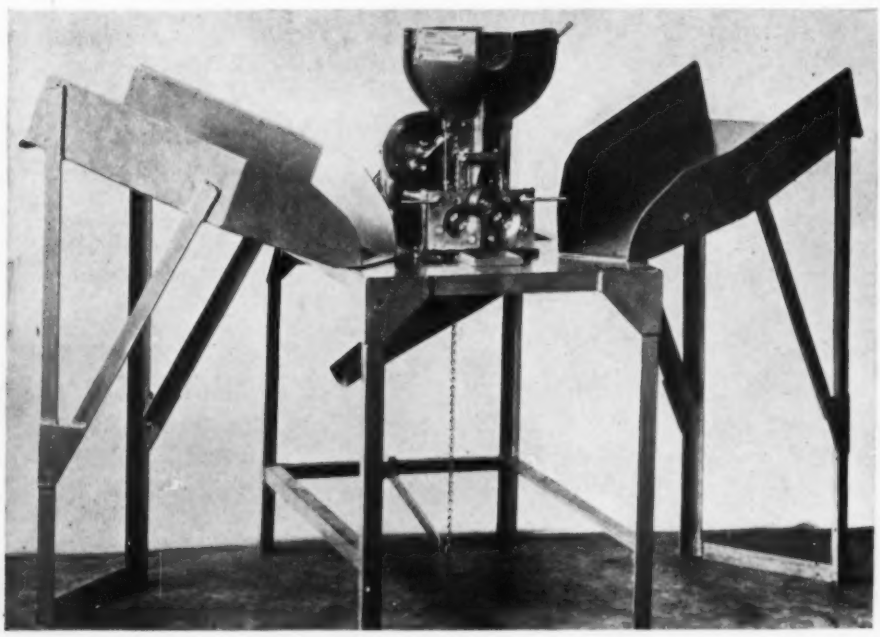
For use in connection with resistance welding machines in which the electrodes of the welder are air- or motor-operated, the Electric Controller & Mfg Co., 2702 E. 79th St., Cleveland, Ohio, has developed an automatic repeat weld timer. This controller is the same as the standard automatic weld timer, except that it has an additional timing circuit for governing the length of time the electrodes of the welding machine are separated to allow the work to be moved to the position where the next weld is desired. The "welding period"



provided by this timer varies in inverse proportion to the rate of current flow, assuring the correct number of heat units are put into each weld, while the "off-time," or period the electrodes are apart, is a definite length of time which is adjustable.

Barrett Lift Truck for Tin Plate

The Barrett-Cravens Co., 3255 W. 30th St., Chicago, Ill., has developed a lift truck for handling the new low 4-in. high skids on which tin-plate is being shipped. The truck, in adition to having the single lift, compound lift and angle lift, is only 3½ in. high in the lowered position. It is 15 in. wide, has a carrying frame 24 in. long, and a clearance between the forks of 5 in. It is capable of lifting loads to 3,500 lb.



THE ROUND TABLE

Chiseling Chisel Prices

The meeting was over but Ed didn't seem inclined to hurry away.

"What's on your mind, Ed?" asked Al.

"Well, if you must know, Al, I've been trying to figure out some of the angles of price fixing that came up in the meeting. Doesn't affect us so much perhaps, and then again, it may. I'm inclined to think that some price fixing may be O.K."

"It's bad medicine, Ed, any way you look at it. But get it out of your system."

"Well, suppose there are six shops making cold chisels. Let them agree on a sales price for 1-inch chisels for the different steels used. Suppose one maker has a hunch he can get more business by cutting his price."

"That's what always happens, Ed."

"O.K., Al. Let him announce a cut. But before he makes it he must have his books audited by government men. If the new price is below cost, or perhaps below a reasonable profit, make him maintain prices or quit the game. If he has devised means of making chisels so he can make a fair profit at the lower cost, let him go to it. If he's just a plain chiseler, he's no use to the community or to his men. If he's brighter than the rest he gets the business until they catch up with him."

"Isn't that what we did before the NRA, Ed?"

"Not exactly, Al. Then we had no check on the price cutter. He could make a lot of good men lose money before he went broke himself. This way he couldn't cut them unless he could prove he was able to make money at the new price."

"Have you ever had any experience with government inspectors?"

"Yes, and it seemed to me most of them were on the level, Al."

"Sure. But how many of them had the guts to break the letter of the law when they could maintain the spirit and get things through by overlooking infractions that didn't affect the functioning of the piece they were inspecting?"

"Well, maybe some of them weren't so hot. But what's that got to do with checking up cost systems?"

"Just this, Ed. You'll have the same kind of man looking for minor infractions, and making trouble over points that really don't matter. No, sir. I don't want any government bookkeepers telling me what to do. Your plan just won't work."

Would Ed's plan make price fixing flexible enough to encourage initiative? Or wouldn't it work—as Al says?

Discussion

The Better Foreman

A foreman should have a thorough understanding of the requirements of the work he supervises, from both a quality and a cost standpoint. However, it is not necessary that he be a skilled workman, although he is frequently strengthened by his ability to turn out any job in the shop. It would seem that the personality and the general background of the foreman should have considerable bearing on the subject. Men of a certain type command respect and get good results without being able to perform expertly any of the tasks they supervise. Other men not possessing strong qualities of leadership and personality depend to a certain extent upon their ability to excel at any job as a means of commanding the respect of their men.

There is one distinct disadvantage associated with having an expert workman as foreman, and that is the danger of his jumping in frequently and personally straightening out troubles, instead of allowing his men to call upon their own resources to work out the solutions. Such action on the part of the foreman usually results in a serious neglect of general supervision of the department.

As a general rule it would seem that it is not necessary for the foreman to be an expert workman, but that such a quality can be of valuable assistance, provided it is used to the best advantage.

—W. E. Benedict,
Plant Engineer,
Sloane-Blabon Corporation.

It is not absolutely essential for a foreman to be able to do a job as well or better than his men. It is the ability to direct that is the most important requisite. The ability or inability to swing a sledge or lap a gage does not in any way influence the foreman's ability to direct man power. The efficient foreman must possess knowledge of what to do and when and how to do it, with the ability to impart that knowledge to others in a manner that will encourage them to call upon him for direction. However, inability to perform the tasks in which he is expected to direct others does not, by any stretch of imagination, make the foreman a master manager.

—L. Kasper.

The Better Foreman

I think that both Al and Ed are right to a certain extent. A foreman in one plant manufacturing a certain kind of equipment may be a success due to his personality and ability to handle men. In another plant under different conditions he would be a total failure if he did not also have operating experience on machines of all kinds and was able to judge whether or not his men were running their machines at the right speeds and feeds or were going about their jobs in the right way.

A foreman who does not thoroughly understand what is being done by his workmen is very often a hindrance to the success of the concern for which he works. Such a man will often make suggestions that retard the work and thus lose the respect of his men, which soon results in their lying down on the job without his being the wiser.

If a foreman is a good judge of men and is able to pick the good ones, he will keep them interested in their work by giving them jobs that will make them think about what they are doing. If he gives his men credit for what they well, it takes the monotony out of their lives and makes them feel that it is worthwhile to put forth their best efforts. —HARRY SWANSON

Al's plan of making a foreman out of the man who is not the most expert workman, but the one who shows leadership, is one of good judgment. Good foremen are not necessarily the best mechanics on the job. A foreman who will have his men work with him, rather than for him, will work quietly and without arguments, and will see that the work in his department is being done in the best way.

Good personal relations with his men should be an every-day matter with the foreman, for upon his shoulders rest the responsibilities for satisfaction and effectiveness. Foremen who are leaders are respected because they have been able to fit themselves for positions above others by virtue of some strong trait.

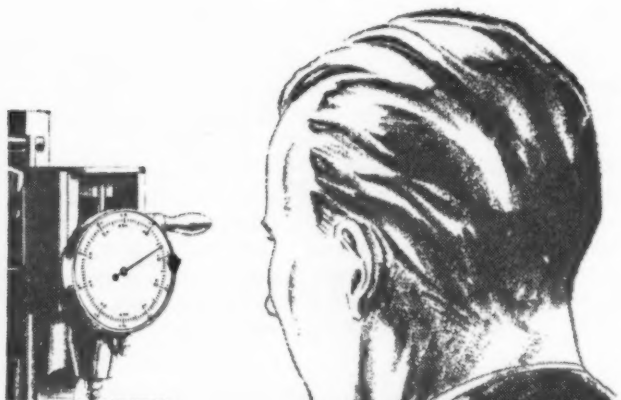
The foreman cannot expect to find qualities in his men that he does not possess or exhibit himself. Gruffness and unfairness may bring about discipline through fear, but they will never instill loyalty and the desire to do one's best on the job.

The good foreman is one who gets the work done efficiently and cheerfully. In order to do this he must be adept in the execution or production end of his work; know that his methods are up to date and not wasteful; that his organization runs smoothly; and that he has the loyalty and good will of his men behind him. R. C. FLOHR.

Ed is right. According to Al's argument there are lots of times when a good mechanic has no chance for promotion, regardless of how skillful a workman he may be. Any mechanic will sometime run against a snag, and if he can't get help from his foreman, who else is he to go to? A foreman should be a first-class mechanic, technically trained. He should be able to tell his men what to do and when to do it, or to do the job himself if necessary.

A foreman who does not help or direct his men in a pinch will not have any influence over them and is the most worthless man on the employer's pay roll. If he is not a good mechanic he will not know whether or not a job is done right, and he will surely give the wrong instructions some time or other and then put the blame for the resulting bad work on some one else.

—H. L. DERBY,
Master Mechanic, Caromount Mills.



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